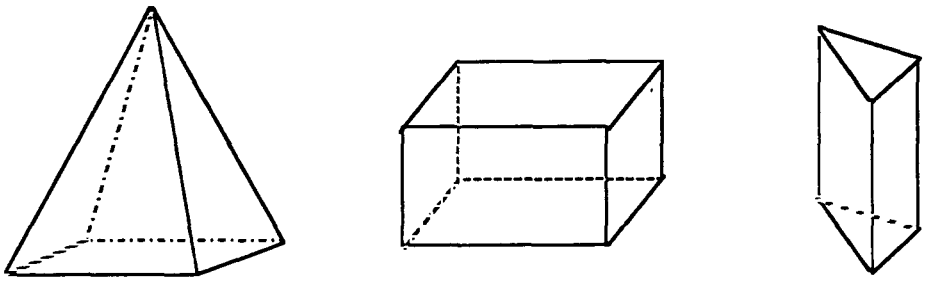
Polyhedrons

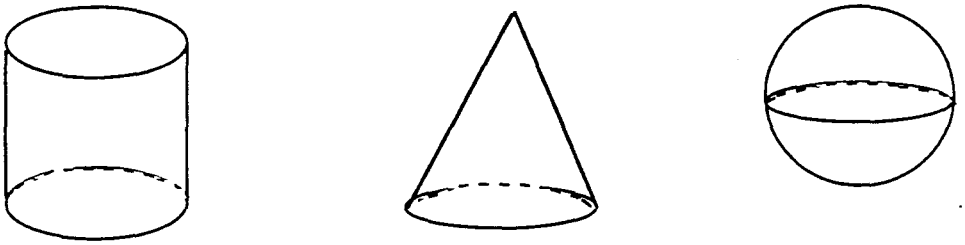
A polyhedron is a space figure whose faces are all polygons.

These are all polyhedrons.



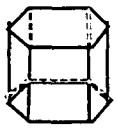
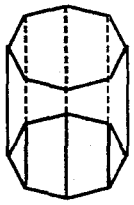
Space figures that have curved surfaces are <u>not</u> polyhedrons.

These are <u>not</u> polyhedrons.



Prisms

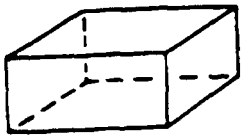
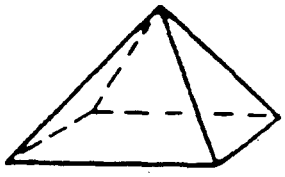
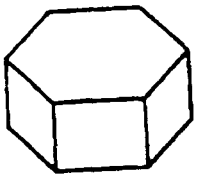
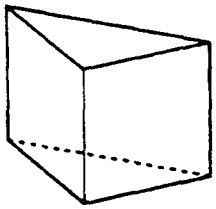
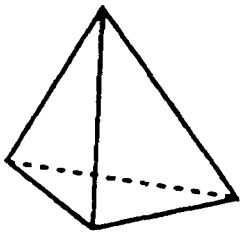
Transparency/Student Copy

Name	Shape of Bases	Number of Sides on Each Base	Number of Faces Which are <u>not</u> Bases	Example
triangular prism				
rectangular prism				
pentagonal prism				
hexagonal prism				
octagonal prism				

Name:_____

Prism or Pyramid?

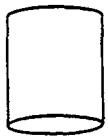
Example: 	2	rectangle	rectangular prism

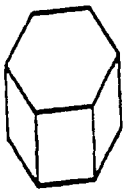
Space Figure	Number of Bases	Shape of Base	Name
			
			
			
			
			

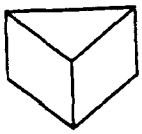
Name: _____

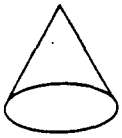
Practice with Polyhedrons

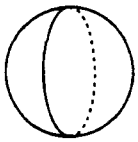
Are these space figures polyhedrons? Check **yes** or **no**.

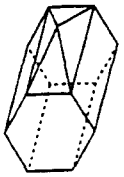
1)  Yes ☐ No ☐

2)  Yes ☐ No ☐

3)  Yes ☐ No ☐

4)  Yes ☐ No ☐

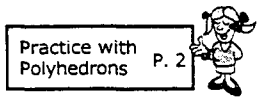
5)  Yes ☐ No ☐

6)  Yes ☐ No ☐

Name the space figure described in the chart.
Use a solid model to help you.

Name of Space Figure	Number of Bases and Faces	Vertices	Edges
	2 bases 3 faces	6	9
	1 base	1	0
	1 base 4 faces	5	8
	2 bases 6 faces	12	18

Name the shapes (bases and faces) and the number of each that you would need to build the solid.



1) Square Pyramid 

Base(s) _____

Faces _____

2) Rectangular Prism 

Base(s) _____

Faces _____

3) Octagonal Prism 

Base(s) _____

Faces _____

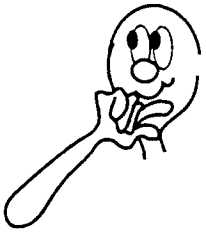
4) Sphere 

Base(s) _____

Faces _____

1) Marta has four congruent triangles. What space figure can she make?

2) Anton has a square and four congruent triangles. What solid figure can he make?



3) Anh has two congruent pentagons and five congruent rectangles. What space figure can she make?

4) Can you name 5 objects in your classroom that are examples of space figures?

OBJECT	***SPACE FIGURE NAME***
1) _____	1) _____
2) _____	2) _____
3) _____	3) _____
4) _____	4) _____
5) _____	5) _____

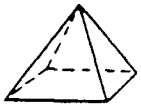
SPACE FIGURES (SOLIDS)

Transparency / Wall Poster

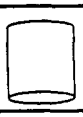
PRISMS

Name	Shape of Base(s)	Number of Other Faces	Shape
Triangular Prism	Triangle	3	
Rectangular Prism	Rectangle	4	
Pentagonal Prism	Pentagon	5	
Hexagonal Prism	Hexagon	6	
Octagonal Prism	Octagon	8	

PYRAMIDS

Triangular Pyramid	Triangle	3	
Square Pyramid	Rectangle	4	
Hexagonal Pyramid	Hexagon	6	
Octagonal Pyramid	Octagon	8	

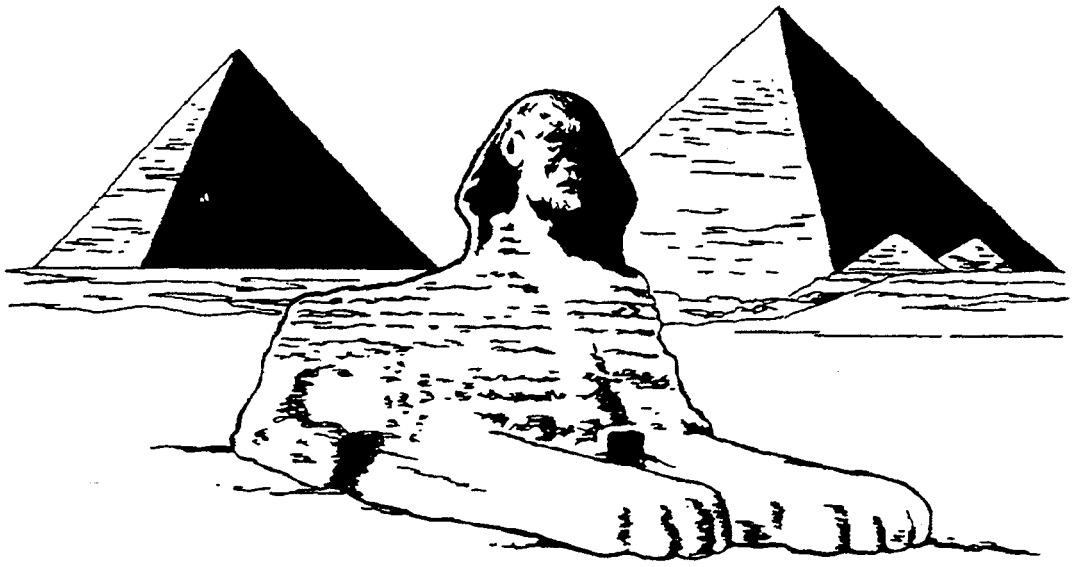
Non-Polyhedron Solids

Cylinder	Circle	Curved Surface	
Cone	Circle	Curved Surface	
Sphere	———	Curved Surface	

The Great Pyramid

When you think of the word *pyramid* what do you think of? Many people think of the pyramids built thousands of years ago.

Pyramids were built in Ancient Egypt as funeral monuments. They were built as tombs for Egyptian pharaohs or kings after they died. The Great Pyramid at Giza is one of the most famous. It was built for the funeral of King Khufu. The Great Sphinx - the lion body - stood nearby to guard the tomb of King Khufu's son, King Khafre.



Pyramid Facts

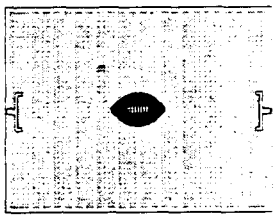
Date Constructed: 2560 BC

Time Needed for Construction: 20 years

Height: 480 feet

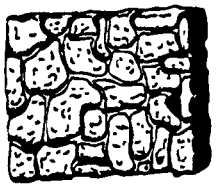
approximately
35 stories high!

Base: a square covering approximately 13 acres
equal to 10 football fields!



x 10

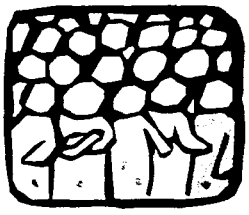
Construction: 2,300,000 stones



Average Weight of Stones: 3 tons
(6,000 lbs.)

Heaviest Stone: 70 tons

Number of Workers: 18,000



Answer Key
Obj.52

Faces, Edges, and Vertices **p.7**

Rectangular Prism	Rectangular Pyramid	Pentagonal Prism
faces 6	faces 5	faces 7
edges 12	edges 8	edges 15
vertices 8	vertices 5	vertices 10

- A cube has **6** faces, **12** edges, and **8** vertices. All the faces of a cube are in the shape of a **square**.
- An octahedron has **8** faces, **12** edges, and **6** vertices. All the faces of an octahedron are in the shapes of a **triangle**.

Prisms p. 9

Name	Shape of Bases	Number of Sides on Each Base	Number of Faces Which are not Bases
triangular prism	triangle	3	3
rectangular prism	rectangle	4	4
pentagonal prism	pentagon	5	5
hexagonal prism	hexagon	6	6
octagonal prism	octagon	8	8

Prism or Pyramid p.10

Figure	# of Bases	Shape of Bases	Name
	2	Rectangles	Rectangular Prism
	1	Rectangle	Rectangular Pyramid
	2	Hexagons	Hexagonal Prism
	2	Triangles	Triangular Prism
	1	Triangle	Triangular Pyramid

Answer Key
Obj.52

Practice with Polyhedrons p. 11

Are these space figures polyhedrons?

1) No 2) Yes 3) Yes
4) No 5) No 6) Yes

Name the space figure described in the chart.

- triangular prism
- cone
- rectangular pyramid
- hexagonal prism

Name the shapes and the number of each needed to build the solid.

1) base= 1 square
faces= 4 congruent triangles

2) base= 2 congruent rectangles
faces= 4 congruent rectangles

3) base= 2 congruent octagons
faces= 8 congruent rectangles

4) base= none (Can't be done -
faces = none spheres are curved surfaces.)

Word Problems

1) Triangular Pyramid
2) Square Pyramid
3) Pentagonal prism
4) Answers will vary.

Objective 53 : Construct and draw space figures. Identify and verbalize the relationships among vertices, faces, and edges of a polyhedron.

Vocabulary

net
cube

Materials

wooden solids
scissors
grid paper
dot paper
tape
shoe box

Transparencies

Faces, Edges, and Vertices
Drawing Cubes and Rectangular Prisms

Student Copies

Making Space Figures Using Nets
Faces, Edges, and Vertices
Will This Net Work?
Drawing Cubes and Rectangular Prisms
Drawing Pyramids
Drawing Cylinders
Drawing Cones
Drawing Space Figures

Language Foundation

1. Explain to students that **net** is an example of a word in English that has many meanings. The common definition is a material made of strings, wires, or threads woven together with regular spaces in between. Students should be familiar with different types of nets such as a hair net, a fishing net, and nets for sports games such as tennis, basketball, and volleyball. Another definition is the amount of money a person earns after paying taxes. Students might know this definition if they have a job and receive a paycheck with their net pay. Explain that net has a different meaning in math which they will learn in this lesson.

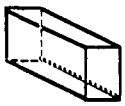
2. **Cube** is another word with different meanings. Students should be familiar with "ice cubes." Explain that a cube in math has 6 equal square sides like a sugar cube, but ice cubes can be different shapes. Students should also know that a cube is the product of the same 3 numbers. For example, 27 is a cube since it is the product of $3 \cdot 3 \cdot 3$. (3^3)

3. Review space figure vocabulary such as face, edge, vertex, prism, pyramid, polyhedron, cylinder, and cone.

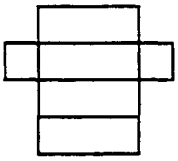
Mathematics Component

1. Build space figures. Use nets to explore the relationship among vertices, faces, and edges of polyhedrons.

   - Refer back to the everyday meanings of the word "net" in the language foundation. Remind students that there are many different meanings for this word.
   - Tell them that there is also a special math meaning for the word net. Explain that in math, a **net** is a two-dimensional shape (having just length and width) which can be folded to make a three-dimensional space figure (having length, width, and height). Tell students that this kind of net is like a "pattern" a tailor uses to make clothes. Tailors use the pattern to cut the cloth into "pattern" pieces. Then they sew the pieces together to make a shirt, blouse, dress, etc. In math, a **net** is a pattern that you cut out of paper and fold to make a space figure.
   - Ask students to close their eyes and think about what a rectangular prism looks like. Tell them to open their eyes and have one student describe the space figure. Record the student's ideas on the board. (Examples might include takes up space, has two rectangular bases, has four other faces which are rectangles, etc.) Hold up the following rectangular prism from a set of wooden solids.



   - Distribute scissors and individual copies of the activity sheet Making Space Figures Using Nets. (**Note**: *You may want to increase the size of the nets by enlarging the activity page on the Xerox machine.*) Have students look at the first net for a rectangular prism. Model cutting around the outside edges as shown below and have students do the same.

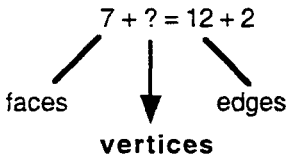


   - Tell students that this net can be folded on the lines to make a rectangular prism. Allow students time to practice folding the net into a rectangular prism. The prisms may be taped together in a few places if desired.
   - Make a transparency and give each student a copy of the activity sheet Faces, Edges, and Vertices. Read the information at the top of the page aloud. Tell students that you will use nets to try to find Euler's formula.
   - Have students count the number of faces, edges, and vertices on the rectangular prisms they have constructed. Model how to record the information in the appropriate place on the chart on the transparency.

- Now have students close their eyes again and tell them to think about what the rectangular prism would look like if the faces were all congruent. Have them open their eyes and show them an example of a cube from a set of solids. Say, "This is a cube. A cube is a special kind of rectangular prism with 6 congruent faces."
- Ask students to use the second net to build a cube. Have them record the number of faces, edges, and vertices on the chart.
- Repeat the above procedure for each of the space figures listed on the chart. First, have students cut the appropriate net. Then, have them construct the net and record the number of faces, edges, and vertices.
- For the last space on the chart, ask students to work in groups to build a net for any space figure they choose which is not on the chart. Provide grid paper and a list of other possible space figures. (For example, the figure could be a pentagonal prism, hexagonal prism, octagonal prism, hexagonal pyramid, octagonal pyramid, etc.) When finished, share results by allowing each group to record information on the transparency chart for one of the new space figures.
- When the chart has been completed, have the students work in groups to look at the data and talk about any relationship they see among the faces, edges, and vertices of <u>all</u> of the space figures. Lead them to understand **Euler's formula** which shows that the number of faces plus the number of vertices is always equal to the number of edges plus two. Model writing the formula at the bottom of the activity sheet and have students do the same. **(F + V = E + 2)**
- Tell students you will play a game called "Find the Number." Write the words "What number?" on the board. Say, "I am thinking of a space figure. It has 7 faces and 12 edges." Record this information on the board. Ask students if they can find the number of vertices on the space figure.

  7 faces
  12 edges
  ? vertices

- Lead students to see that they can use Euler's formula (F + V = E + 2) to find the missing number of vertices. Show that it would be 7 because:



(Note for the teacher: The shape is a hexagonal pyramid.)

- Play several more rounds of "Find the Number" until students understand that Euler's formula can be used to find a missing number of faces, edges, <u>or</u> vertices if <u>two</u> of the numbers are known. Then, they can identify the space figure with that number of faces, edges, and vertices.

Examples: Provide students with two attributes and have them use Euler's formula (F + V = E + 2) to guess the missing third attribute. Vary the missing attribute. Then, have them try to identify the space figure with that number of faces, edges, and vertices.

1) 5 faces
? edges
6 vertices

2) **? faces**
12 edges
8 vertices

Answers: 9 edges (triangular prism)

5 + 6 = ? + 2

faces vertices **edges**

6 faces (cube)

? + 8 = 12 + 2

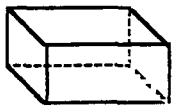
faces vertices edges

- One net is included for a space figure which is not a polyhedron - a cylinder. Have students fold the cylinder and then discuss how this space figure is different from the others. (It is not a polyhedron because it does not have only flat surfaces or faces.) Ask students to give reasons why they could or could not use Euler's formula with a cylinder.

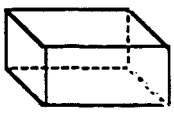
2. Explore nets used to construct space figures.
   - Divide students into 5 groups. Give each group scissors, grid paper, and a paper copy of one of the nets from the activity sheet Making Space Figures Using Nets used in activity 1 above.
   - Have groups work to see if they can create a different net for the same space figure. Do not have them tape the space figures together.
   - Have groups share their results. Paste any nets students find onto a poster board or chart paper with the names of the appropriate space figures written above the nets. (See answer key for some other possible nets.) Challenge students to bring you other nets they might find or create in the future.
   - Distribute a copy of Will This Net Work? to each group. Have students look at page 1. Explain that this page will be used to record answers. Tell them to talk with their group and guess whether each net would form the appropriate space figure. Have them circle "yes" or "no" for each problem. Then tell them to cut out each net on page 2 and try to fold them into the appropriate space figure. They should record the results on page 1. Encourage students to discuss ideas with each other as they complete this activity.

3. Draw space figures.
   - Draw the following illustration on the board.

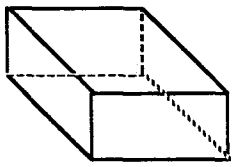
- Ask students what you have drawn and elicit responses. (Responses might include a rectangle, a quadrilateral, or a polygon.)
- Tell students that you wanted to draw a box that a pair of shoes would fit in. Show students an example of a shoe box. Ask them how you could make the picture look more like a real shoe box. Have students share ideas. Lead students to understand that a three-dimensional drawing would look more like the real object.



- Ask students what space figure a shoe box represents. Elicit that the shoe box is in the shape of a **rectangular prism**.
- Say, "To make a drawing of a space figure look realistic, we need to think about what parts of the space figure we can see when we look at it." Hold the shoe box to illustrate that the part of the box that we see will be different depending on how we look at it.
- Tell students that they will practice drawing space figures on a special kind of paper called dot paper. Explain that the paper makes it easier to draw three-dimensional objects. Make a transparency and distribute copies to students of the first activity sheet Drawing Cubes and Rectangular Prisms. Read the directions for Step 1 and Step 2 at the top of the page together and model following the directions to begin drawing a rectangular prism on the dot paper.
- Hold up the shoe box before reading Step 3 to help illustrate the parts of the box which would be visible and the edges which would be hidden inside the box. Take the lid off the box to help students see the hidden edges and/or faces.
- Ask students how we could draw a **cube**. Have them share their ideas. Show students that drawing overlapping square faces for Step 1 would result in a cube instead of a rectangular prism.
- Talk about ways to draw other prisms such as pentagonal or hexagonal. Lead students to understand that the shape of the bases used in Step 1 will determine the type of prism.
- Model how to begin a drawing with two faces that do not overlap. Tell students that if they connect the corresponding vertices, they will get a different rectangular prism.



This rectangular prism began with overlapping faces.

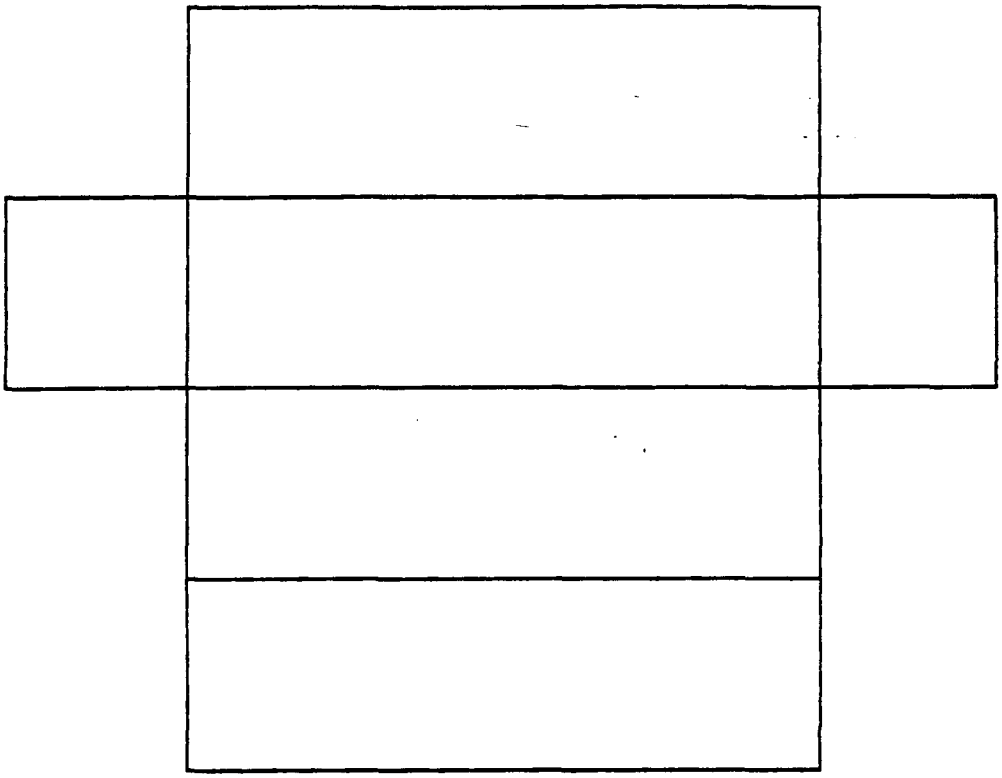


This rectangular prism did not begin with overlapping faces.

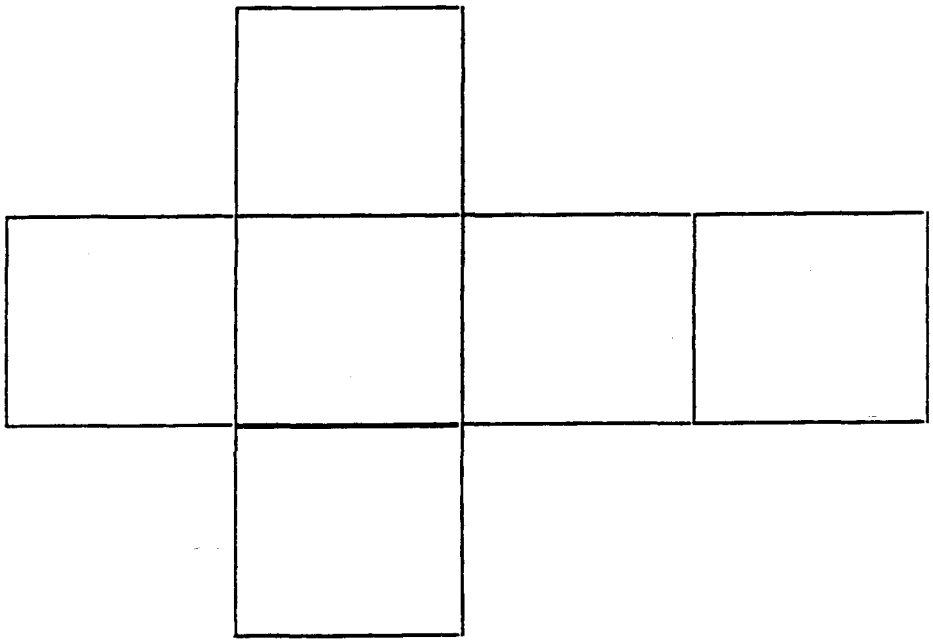
- Provide time for students to explore drawing other prisms and cubes on the dot paper.
- Repeat the same procedure for the activity sheets Drawing Pyramids, Drawing Cylinders, and Drawing Cones. Encourage students to be creative and to practice drawing space figures from different views. You may want to post students' work in the room so that students can talk about and learn techniques for drawing prisms from their peers.
- A blank piece of grid paper, Drawing Space Figures, is included for further practice drawing.

Making Space Figures Using Nets

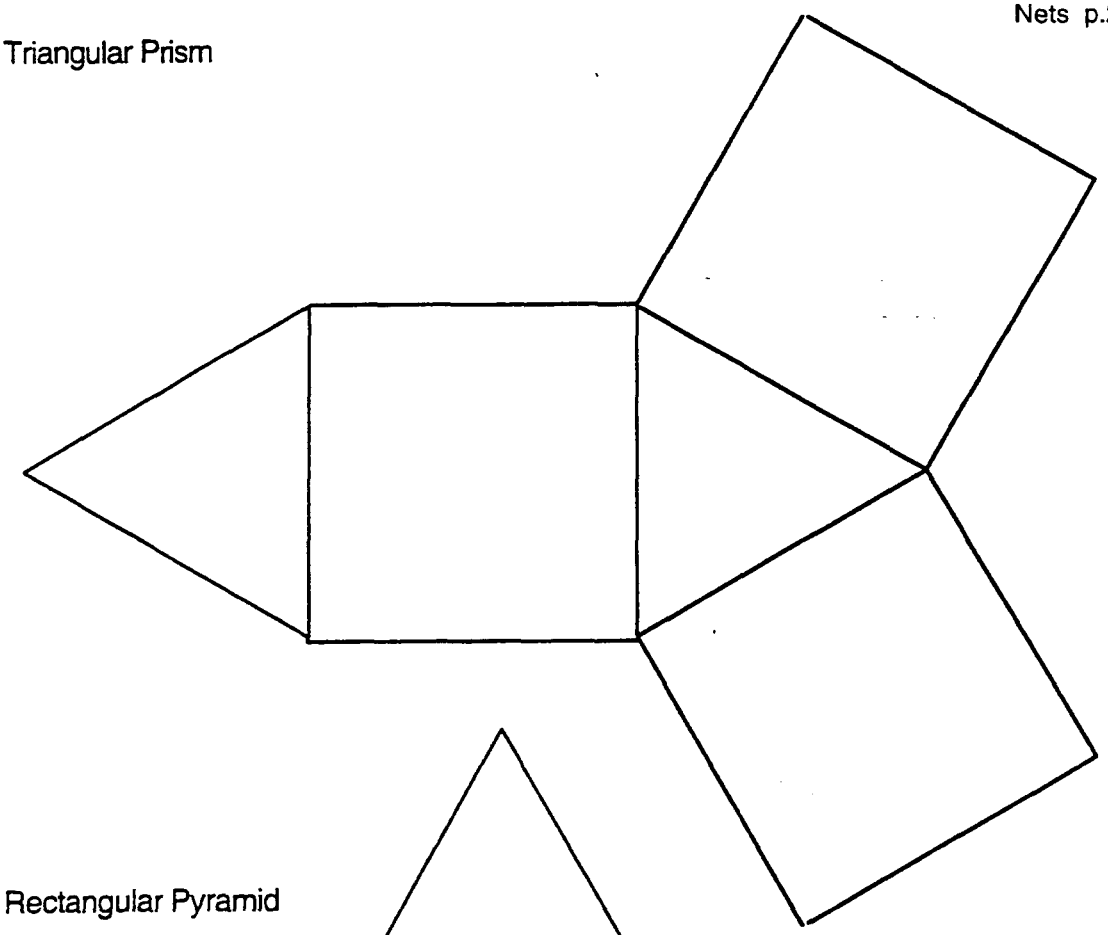
1. Rectangular Prism



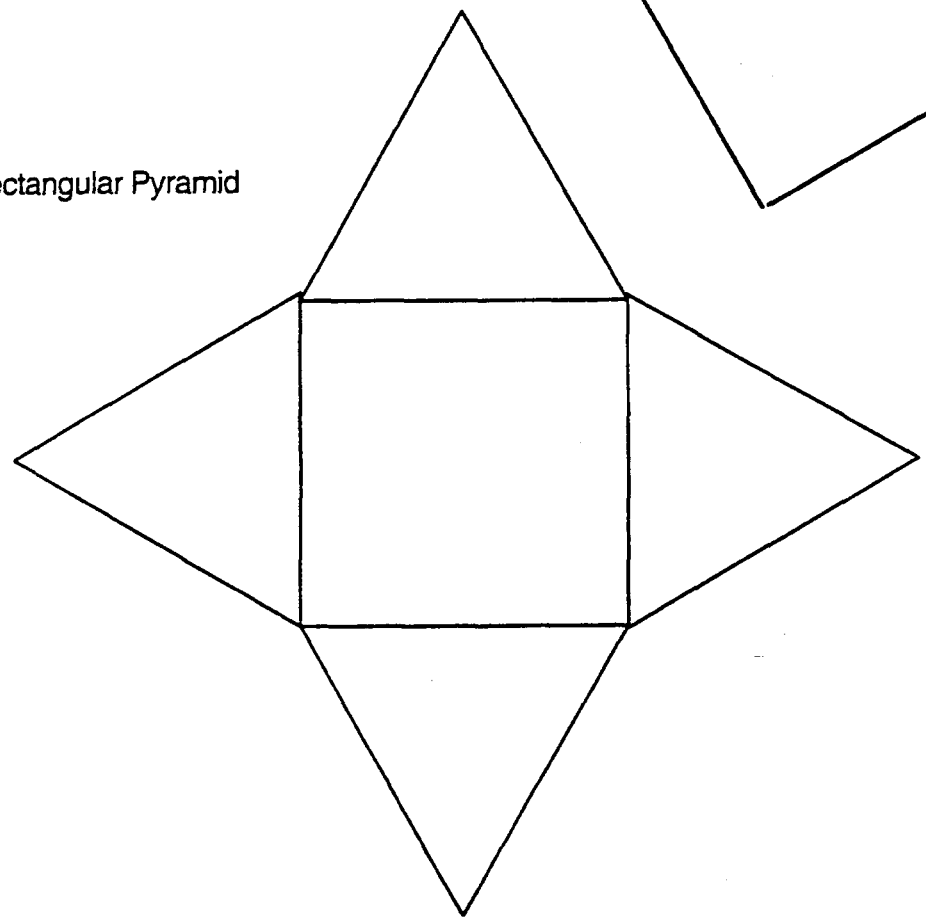
2. Cube



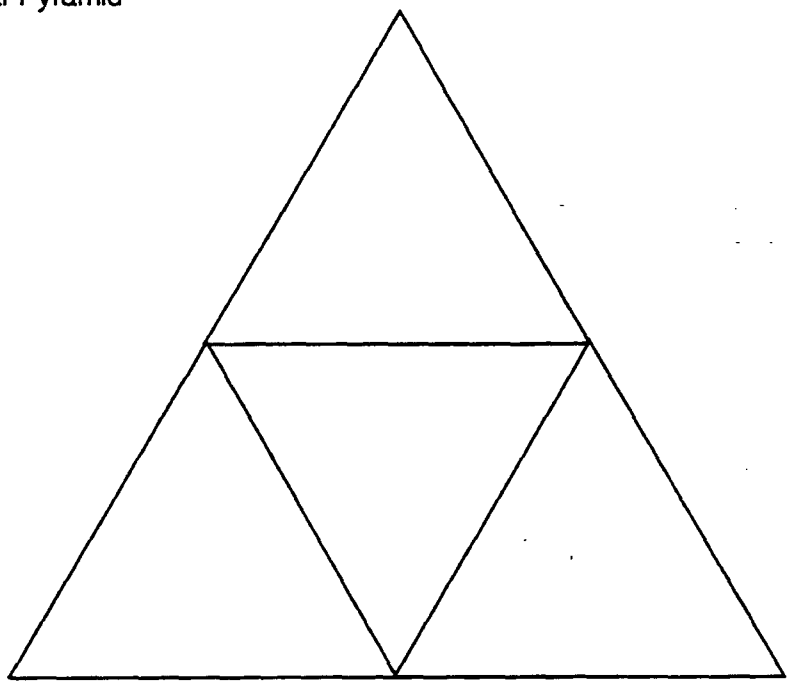
3. Triangular Prism



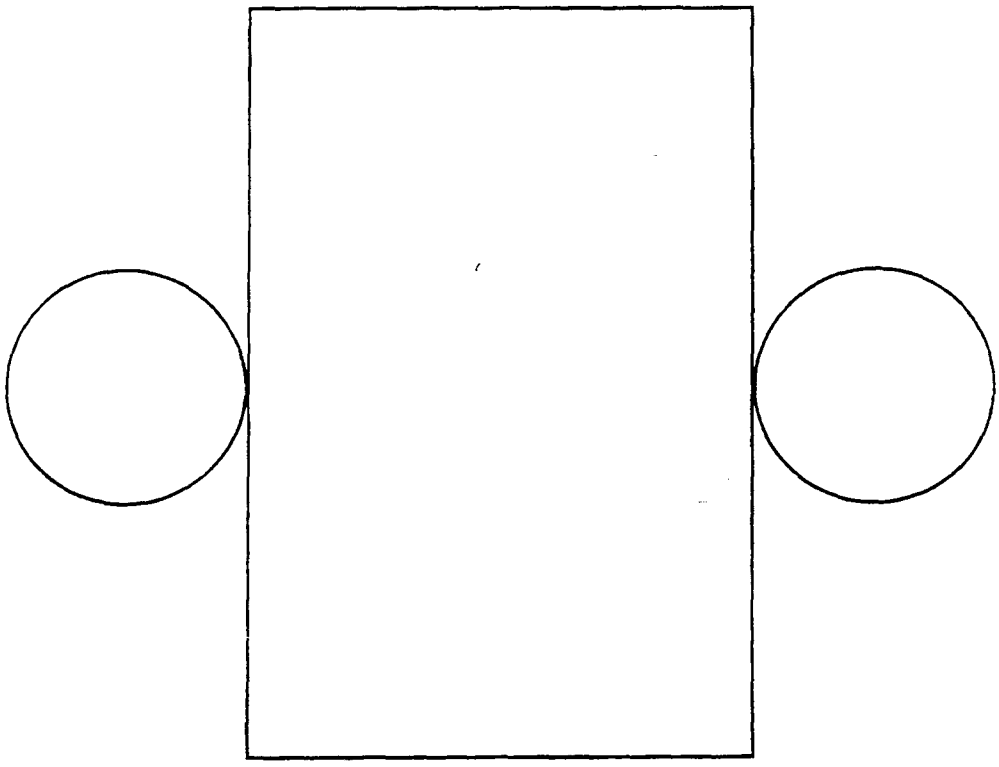
4. Rectangular Pyramid



5. Triangular Pyramid



6. Cylinder

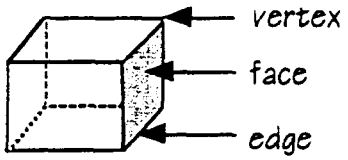


Name _____
Date _____

Faces, Edges, and Vertices

Leonard Euler was a Swiss mathematician born in 1707. He spent most of his life teaching math in Russia and Germany. When he was a young man, he began to lose his eyesight. Later, he became completely blind. He still made many important discoveries in math.

Euler found something interesting about the faces, edges, and vertices of polyhedrons. See if you can discover what he found. It is called **Euler's Formula**.



Polyhedron	F Faces	V Vertices	E Edges
rectangular prism			
cube			
triangular prism			
rectangular pyramid			
triangular pyramid			

Do you see a pattern? _____

_____

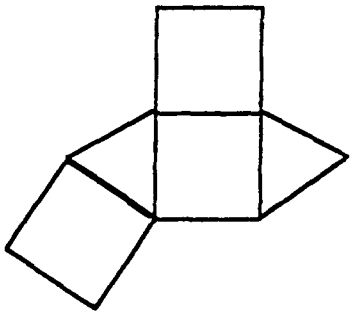
Write Euler's Formula: _____

Name:_____

Will This Net Work?

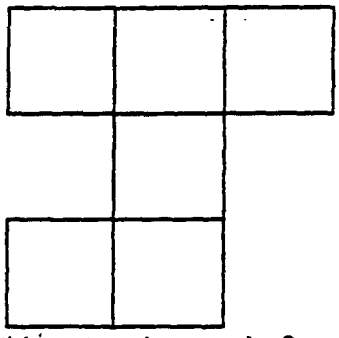
- First, guess whether the net will work to form the space figure. Circle yes or no.
- Then, cut the net on page 2 and try to make the space figure.
- Circle yes or no on page 1 to show if the net does make the space figure.

1. Guess: Yes No



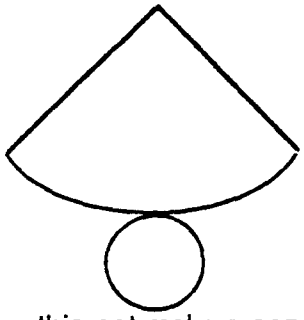
Does this net make a **prism**?
Yes No

2. Guess: Yes No



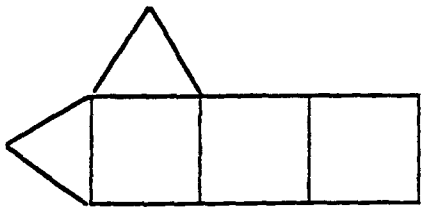
Does this net make a **cube**?
Yes No

3. Guess: Yes No



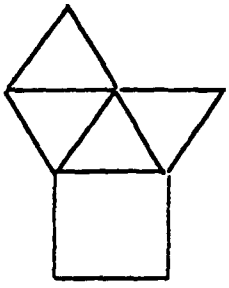
Does this net make a **cone**?
Yes No

4. Guess: Yes No



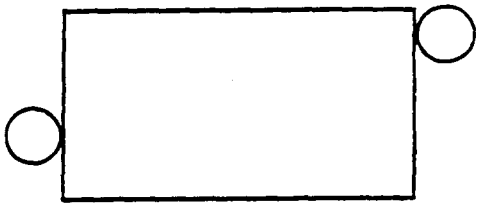
Does this net make a **prism**?
Yes No

5. Guess: Yes No



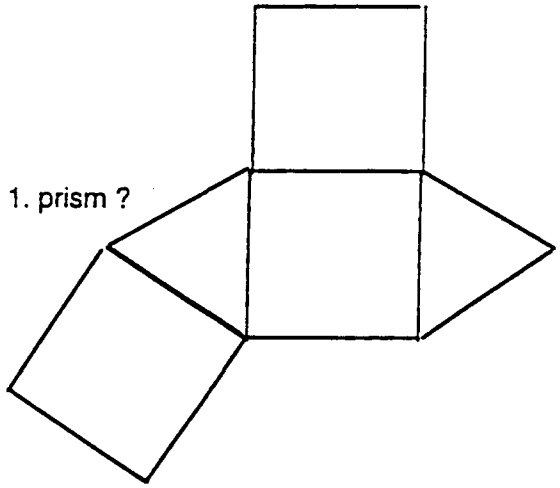
Does this net make a **pyramid**?
Yes No

6. Guess: Yes No

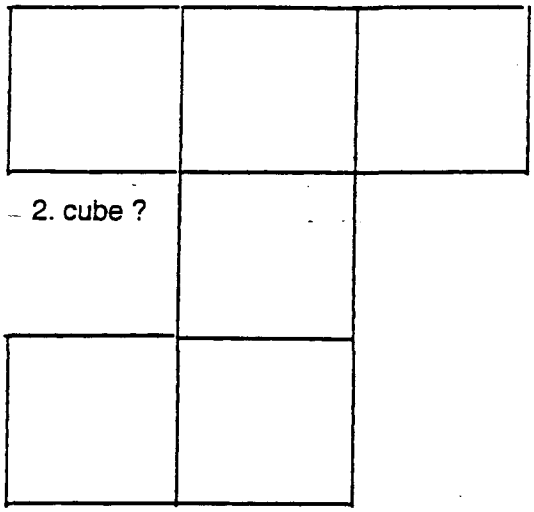


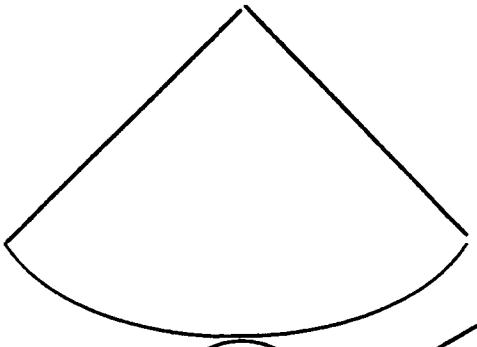
Does this net make a **cylinder**?
Yes No

1. prism ?

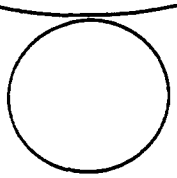


2. cube ?

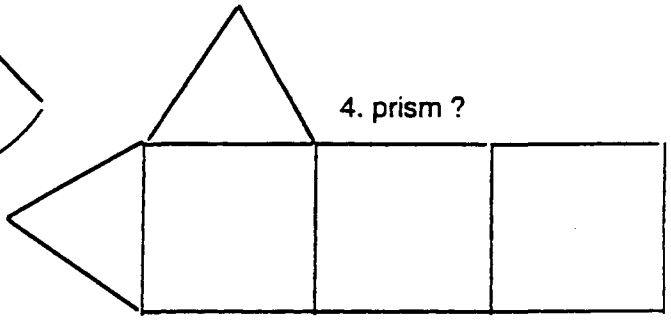




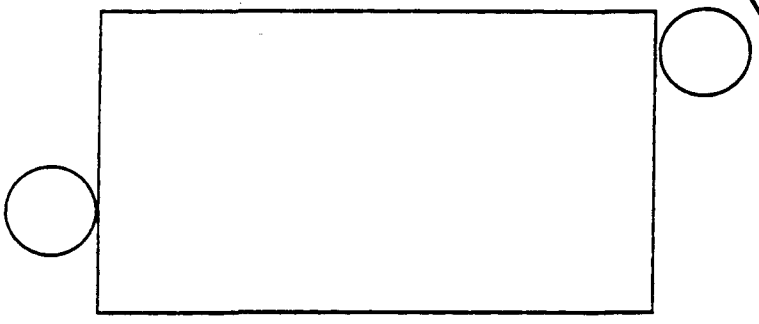
3. cone ?



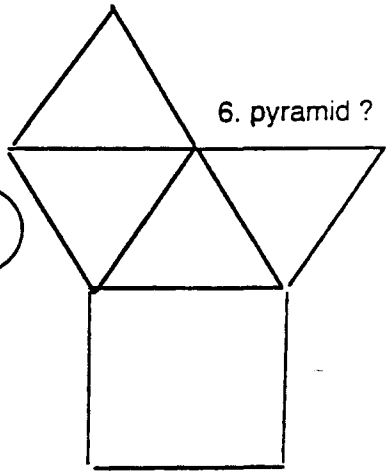
4. prism ?



5. cylinder ?

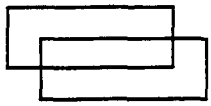
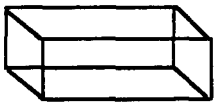
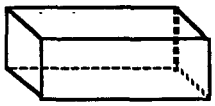


6. pyramid ?



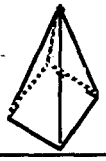
Name _____

Drawing Cubes and Rectangular Prisms

1) Draw two **congruent** rectangles. Make them parallel and overlapping.	2) Connect the corresponding **vertices**.	3) Draw dashed lines for the edges that are **hidden** from view.
		

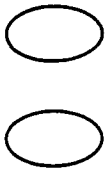
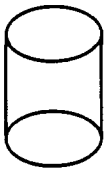
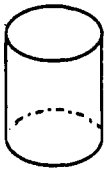
Name: _____

Drawing Pyramids

1) Draw a **square** standing on one corner. Draw a **point** above the square.	2) Draw line segments from each **vertex** of the square to the point.	2) Draw dashed lines to show the edges which are **hidden** from view.
		

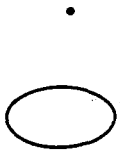
Name:_____

Drawing Cylinders

1) Draw two ovals to show the bases.	2) Draw line segments to connect the bases.	3) Draw a dashed line to show the part of the base which is **hidden** from view.
		

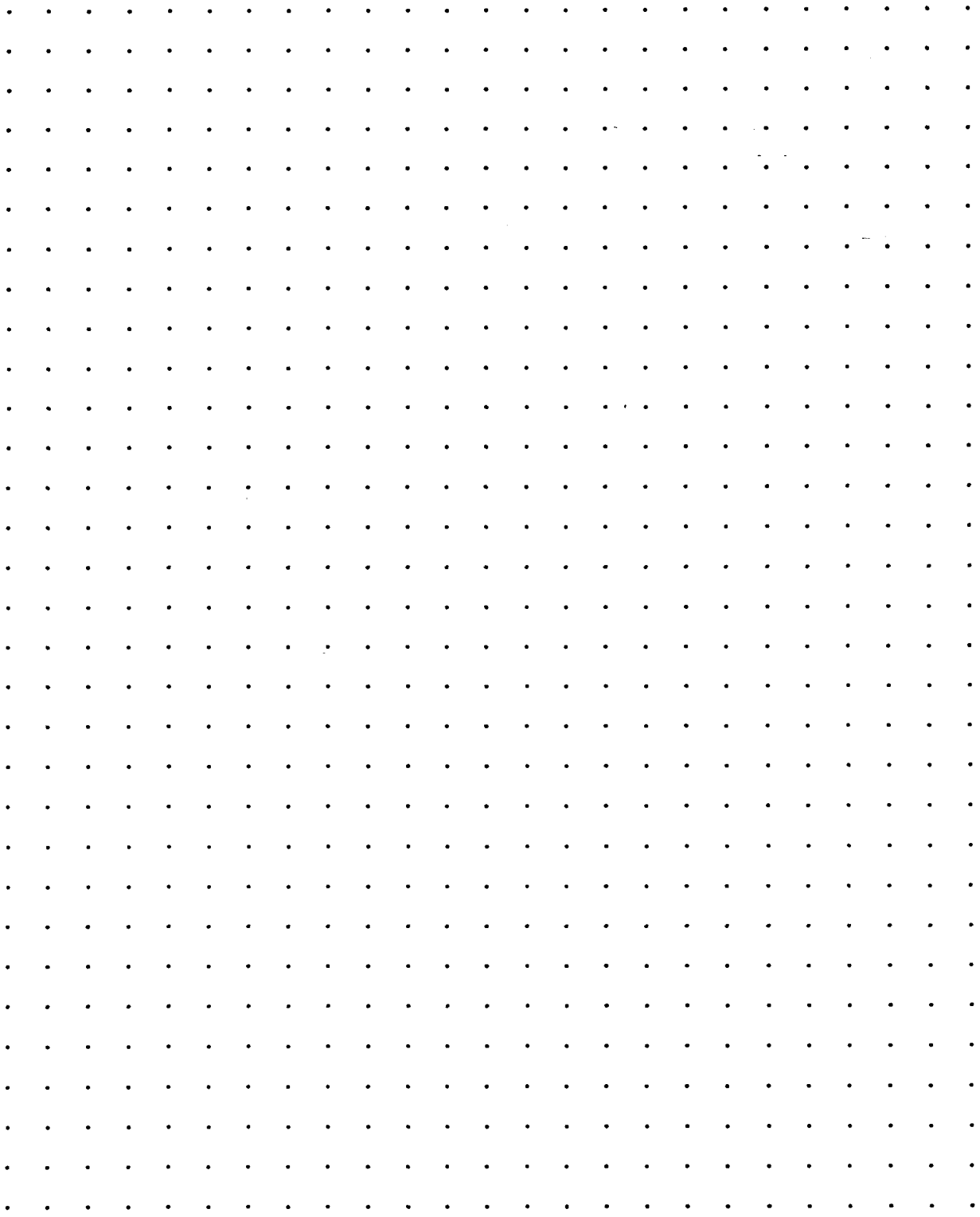
Name:_____

Drawing Cones

1) Draw an **oval** to show the base. Draw a **point** above the oval.	2) Draw two **line segments** connecting the point to the base.	2) Draw a dashed line to show the part of the base which is **hidden**.
		

Name_____

Drawing Space Figures



Answer Key
Obj. 53

Polyhedron	Faces	Vertices	Edges
Rectangular Prism	6	8	12
Cube	6	8	12
Triangular Prism	5	6	9
Rectangular Pyramid	5	5	8
Triangular Pyramid	4	4	6

Pattern - The sum of the faces and the vertices is always two more than the number of edges.
Euler's Formula = F + V = E + 2

Will this net work?

1) Yes
2) No
3) Yes
4) No
5) Yes
6) No

Obj. 54: Investigate surface area and volume of rectangular prisms.

Vocabulary

surface area
volume
square units
cubic units

Materials

nets from Objective 52
clear metric ruler
rulers
empty boxes of various sizes
multilink cubes

Transparencies

- Investigating Surface Area
- Amount of Surface Area
- Akeem's Gift
- Exploring Volume
- Understanding Volume

Student Copies

- Akeem's Gift
- Finding Surface Area
- Surface Area of Rectangular Prisms
- Finding Volume
- Volume of Rectangular Prisms
- Surface Area vs. Volume
- Investigating Boxes
- Notes: Understanding Volume

Language Foundation

1. Ask students what they think the word surface means. Elicit responses and have students describe the "surface" of various objects in the room such as a desk, table, or box. Talk about the surface of the ocean and the earth's surface. If available, use a globe to point out that the earth is covered with both water and land. Have students come up to the globe to point out these surfaces.

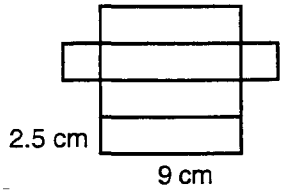
2. Remind students of the meaning of the term **area**. Combine area with the term surface and ask students what they think is the meaning of **surface area**. Have students look at some of the nets displayed in the room from the previous lesson. Ask if anyone can explain how he/she could use these nets to determine the surface area of prisms. Tell students they will learn how to find the **surface area** of rectangular prisms in this lesson.

3. Tell students the word volume has more than one meaning in English. It can mean one of many books in a set such as an encyclopedia volume or one volume in a set of poetry books. It can also mean the amount of sound that comes from the TV, radio, or a CD. Explain to students that in math **volume** is the amount of space it takes to fill the inside of a figure. Tell students that in this lesson they will look at space figures and will learn how to find the **volume** of rectangular prisms.

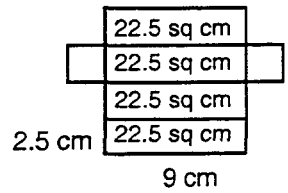
4. Review space figure vocabulary such as face, edge, vertex, and prism.

Mathematics Component

1. Explore the concept of surface area.
   - Go back to Objective 52 and find the activity page Making Space Figures Using Nets. Make a copy of the net for a rectangular prism and cut it out.
   - Place the transparency Investigating Surface Area on the overhead.
   - Use the net from Objective 52 to model as you read each piece of information on the transparency. Lead students to see the connection between surface area and the net used to construct the prism. Use the paper model and the transparency to explain that **surface area** is all of the faces of the prism, including the bases.
   - Place the transparency Amount of Surface Area on the overhead, read the definition of surface area aloud and then the question below it.
   - Hold up the paper model. Point to all of the faces as you say, "How much surface area is there in all?" *Students will probably struggle with this question since there is not enough information to be* able to determine a total "amount" of surface area. Lead students to understand that to find an "amount," they need certain numbers or data.
   - Shade one face of the prism on the transparency net as shown below. Use a clear metric ruler to model measuring the length and width of the shaded area. Record the information on the transparency.

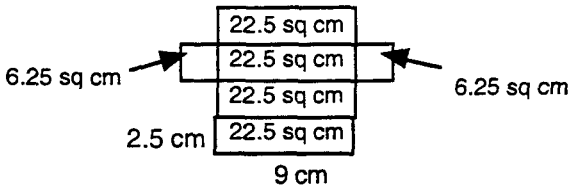


   - Ask, "What is the **area** of this shaded space? If students seem unclear, review the meaning of area by asking, "How many square units would fit in this rectangle?" (9 cm x 2.5 cm = 22.5 sq cm)
   - Now point as you say, "The area of this rectangle is 22.5 square centimeters. Is this the total ***surface area*** *of the prism? Why or why not?" Allow students to share their ideas.* (No, it is not the total surface area. We know the area of one face. Surface area is all of the faces, including the bases.)
   - Say, "How can we find the area of all of the faces, including the bases. Lead students to understand that there are three other faces which are congruent to the shaded face. Therefore, the area of each is 22.5 square centimeters. Record this information as shown.



   - Ask if students know the total surface area of the prism? (No, they do not know the area of the two bases.)
   - Have students explain how to find the area of the two bases and record as shown.

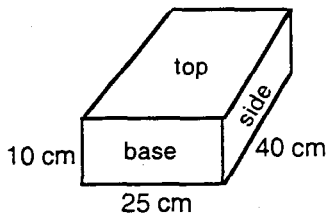
(They can measure one of the square bases and then find the area. Each base is 2.5 cm x 2. 5 cm = 6. 25 sq c.)



- Record the area of the bases on the transparency. Discuss with students how we can use all of this information to find the total **surface area** of the prism. Lead students to understand that the area of each of the faces and the two bases can be added together to get the total surface area of the prism.
- List the area of each of the six faces on the transparency and have a student come up to find the sum. (22.5 + 22.5 + 22.5 + 22.5 + 6.25 + 6.25 = 102.5 sq cm)
- Remind students that, "**Surface area** is all of the faces and all of the bases. You can find the total amount of surface area by measuring each of the faces, finding their areas, and then adding the areas of all of the faces together." Surface area is always measured in square units. The total amount of surface area of this prism is 102.5 sq cm.
- Hold up a box as a real-life example of a rectangular prism. Have a student point out the parts which make up the surface area. (All of the faces, including the two bases.) Ask students to explain how they could find the total amount of surface area. Model measuring all of the faces, finding the area of each of the faces, and then adding them together to get the total amount of surface area of the prism.
- Tell students that there are times when it is important to know the total amount of surface area. Place the transparency Akeem's Gift on the overhead. Read the problem and the question aloud. Have students raise their hands to show whether they think Akeem does or does not have enough paper to wrap the gift.
- Divide students into groups. Give each group a copy of Akeem's Gift. Say, "Work with your group to find out if Akeem has enough paper. Show how you get your answer." Allow time for students to solve the problem.
- Have each group share their ideas. Lead them to see that in order to determine if Akeem has enough paper, they need to know the total amount of surface area on the box.

Area of Faces

Bases - 25 x 10 = 250 sq cm
Other Faces -
Two sides - 40 x 10 = 400 sq cm
Top and bottom - 40 x 25 = 1000 sq cm

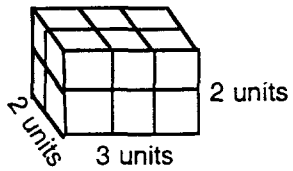


Total Amount of Surface Area

250
250
400
400
1000
1000
3300 sq. cm

Akeem does not have enough paper to wrap the gift!

- Point out that the total amount of surface area includes a top and bottom of equal size, two sides which are a different size from the top and bottom, and two bases which are equal in size.
- Ask students to think of other times when they might need to know the total amount of surface area. Have students share ideas. (One example would be buying paint to paint a room. The total surface area of all of the walls to be painted would be needed. A second example would be buying carpet to cover several rooms. The total surface area of all of the floors would be needed.)
- Distribute copies of the activity sheet Finding Surface Area. Go over the example together, reminding students that total surface area includes the two bases, the top and bottom, and two sides. Since there are six faces on a rectangular prism, there are six measurements needed to find total surface area. Students may complete this activity individually or in pairs.
- The activity sheet Surface Area of Rectangular Prisms is also included for additional reinforcement. Distribute an activity sheet to each pair of students. Go over the directions together. Tell students that for the first problem, they will use 12 cubes to build as many rectangular prisms as possible. For each prism, they will record the length, width, and height of the prism and then calculate its total surface area. Model building a 3 x 2 x 2 prism using 12 cubes.



- Point out where the length, width, and height of the prism are recorded on the activity page. (3 x 2 x 2) Then have students count the total surface area. (32 sq units) Point out where the total surface area of the prism is recorded on the activity sheet.
- Have students work with their partner to build other prisms which have different dimensions, but still use only 12 cubes. Share results and record information for each prism on the chart. Students can also build:

Length, Width, and Height	Total Surface Area
12 x 1 x 1	50 sq units
6 x 2 x 1	40 sq units
4 x 3 x 1	38 sq units

- *Once they have built and recorded information for all possible prisms using 12 cubes, have them repeat the same procedure using 16 cubes, then 18 cubes, and then 24 cubes.*

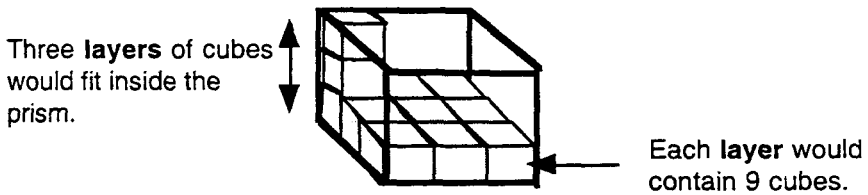
2. Explore the concept of volume.
   - Show students an empty box . Briefly review the concept of surface area by pointing out that surface area includes all of the faces of the box, including the bases. Remind students that if they were covering the outside of the box with paper they would need to know the total amount of surface area. Surface area is measured in square units.

- Tell students that there is another way that we can measure the box. We can measure the amount of space inside the box. Explain that this type of measurement is called **volume.**
- Place the transparency Exploring Volume on the overhead. Read the information aloud using the illustrations to reinforce each idea. Important concepts for students to gain include:
    - a definition of volume as the amount of space inside a three-dimensional figure
    - an understanding that volume is measured by the number of cubic units that fit inside a space figure
    - an understanding that there are many different cubic units which can be used to measure (including cubic inches, cubic centimeters, cubic yards, etc.)
    - an understanding that a cubic unit measures the same on all sides (a cubic centimeter is one centimeter on all sides, a cubic inch is one inch on all sides, etc.)
    - an understanding that there is a shortened way to write cubic units using 3 as an exponent

      (For example, 6 cubic centimeters may also be written as 6 cm^3.◄—)

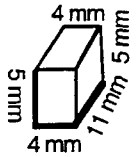
- Distribute student copies of the activity sheet Finding Volume. Tell students that one way to find the volume of these prisms is to count the number of cubic units that would fill the space inside the prisms. Have students look at the two examples at the top of the page. Ask how many units would fit inside the first prism and have students share their reasoning. (One strategy would be to think of three layers with 9 cubic centimeters in each layer. The total volume is 9 x 3 or 27 cm^3.)

Example 1



- Share strategies for counting the volume of the second example. (There are two layers with 6 cubes in each layer. The volume is 12 cm^3.) Have students complete this activity sheet as class work or as homework.
- A transition into using a formula to find the volume of a rectangular prism is provided on the activity sheet Volume of Rectangular Prisms. Read the top of the page together and lead students to see that there are times when it is not possible to count the total number of square units. Explain that a formula may be used in place of counting. (We can find the volume of a rectangular prism by multiplying the length, width, and height. The formula is V = l x w x h.) Begin the first few problems together.

Note: Be sure to point out that problems 5 - 8 include some dimensions that are written more than once. Students may need practice in choosing the three dimensions needed to find volume. Problem 5 is illustrated below.

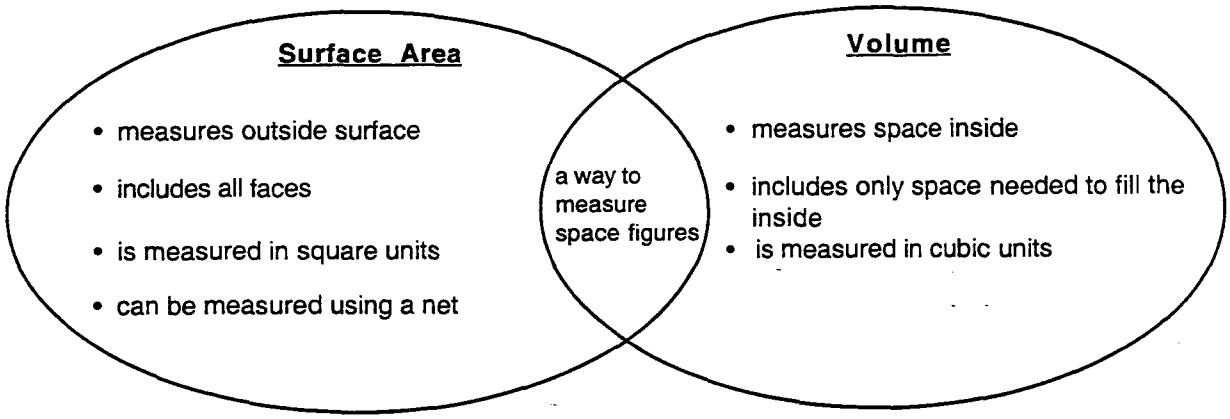
5. 

Students need to select <u>one measurement for each dimension</u>: length, width, and height. Length is 11 mm, width is 4mm, and height is 5 mm. The volume of this prism is 11 x 4 x 5 which is 220 cubic mm.

3. Compare and contrast surface area and volume.
   - Write "surface area" on the board. Ask students to think for a minute about all of the things they know about surface area. Then, ask different students to share their ideas and make as list on the board as students respond.
   - Repeat the same procedure for volume, linking contrasting ideas as shown below.

Surface Area		**Volume**
• a way to measure space figures	◄——►	• a way to measure space figures
• measures outside surface	◄——►	• measures space inside
• includes all faces	◄——►	• includes only space needed to fill inside
• is measured in square units	◄——►	• is measured in cubic units
• can be measured using a net		

   - Give each student a copy of the activity sheet <u>Surface Area vs. Volume</u>. Place a transparency copy of the activity sheet on the overhead.
   - Read the two titles written on the venn diagram. Tell students that now they will use a venn diagram to compare and record the information on the board.
   - Ask a student to look at the list on the board and read something that is the <u>same</u> about surface area and volume.
   - Record the common fact (a way to measure space figures) on the venn diagram as shown below. Have students copy the information onto their own venn diagrams.
   - Point to the side labeled "**Surface Area**." Ask a student to look at the list on the board and read one thing they have learned about surface area. List the student's idea in the appropriate place on the transparency as shown below.
   - After listing one fact about surface area, ask a different student to look at the board and explain how this fact would be <u>different</u> for "volume." List the contrasting fact across from the first fact on the side labeled "**Volume**." For example, surface area measures the outside surface of a space figure; however, volume measures the space inside a space figure.
   - As you lead students to verbalize each of the contrasting facts written on the board, write each one on the transparency and then have students copy onto their own papers.



4. Investigate a real-world application of surface area and volume of rectangular prisms.
   - Each student will need two small cardboard boxes with different shapes and sizes for this activity. Students may bring the boxes from home. It is suggested that the teacher have extra boxes available.
   - Give each student a copy of Investigating Boxes.
   - The first page of the activity will focus on **volume** of the boxes. Read the page together.
   - Have students make a prediction on which of their boxes will hold the most cubic units.
   - Then have students find the volume of the boxes in two different ways. First, they will fill each box with cubes and "count" the number of cubes which most closely fit inside each box. Have students record their information in the column labeled "Volume (Counting)" on the chart on page 3 of the activity sheet.
   - Next, provide metric rulers and have students measure the dimensions of each box (length, width, and height) to the nearest tenth of a centimeter. Students should then find the volume of each box using the formula V = l x w x h. Have students record their answers in the column labeled "Volume (Formula)" on the chart on page 3 of the activity sheet.
   - The second page of the activity will focus on **surface area** of the boxes. Read page 2 together.
   - Ask students to fill in their predictions for which box has the greatest and the least amount of surface area.
   - Students will find the surface area of their boxes in two ways. First, have them follow the directions given for making a net for each box on grid paper. Be sure they understand that the nets must fold into the shapes of their boxes.
   - Have students count the number of square units in each net as close as possible and record the information in the column labeled "Surface Area (Using a Net)" on page 3 of the activity sheet.
   - Next, have students use metric rulers to measure the length and width of each of the faces on one of their boxes. Then they should multiply to find the area of each face and add the area of the six faces together to find the total surface area of the box. Students should record their results in the column labeled "Surface Area (Computation)" on the chart on page page 3 of the activity sheet.

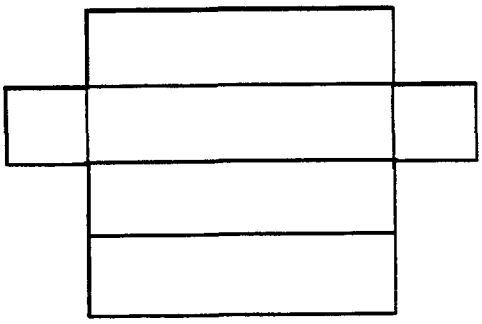
- Ask students to repeat the same procedure for the second box.
- On page 3 of the activity sheet, tell students to use the information on their charts on page 3 to write answers for the five questions. (Note: For question 5, some students may notice and be surprised that the ratio of surface area to volume gets smaller as the box gets bigger.)

Language Development Activities

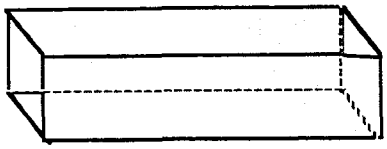
- Notetaking

  Depending on their level of English language writing proficiency, taking notes will help students reinforce concepts, practice key vocabulary, and improve their writing skills. Distribute individual student copies of Notes: Understanding Volume. Place the transparency Understanding Volume on the overhead. One-by-one, review each of the key concepts. For each concept, allow time for students to copy notes onto their page. Help students to see that they don't need to write down exactly what is on the overhead. They can write a shortened form on their paper. For example, they don't need to write "It is".

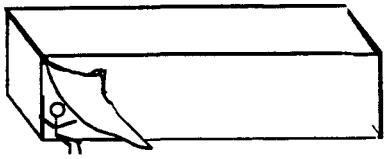
Investigating Surface Area



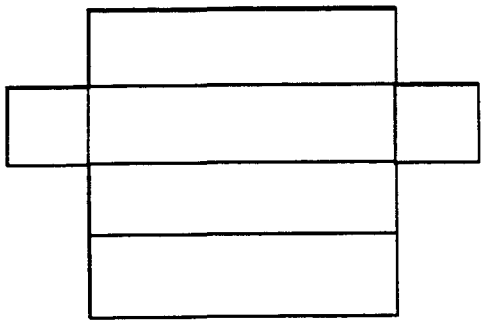
This is a net for a rectangular prism.



The net can be folded to make a prism.



The prism can be unfolded to look at all of its <u>faces</u>.

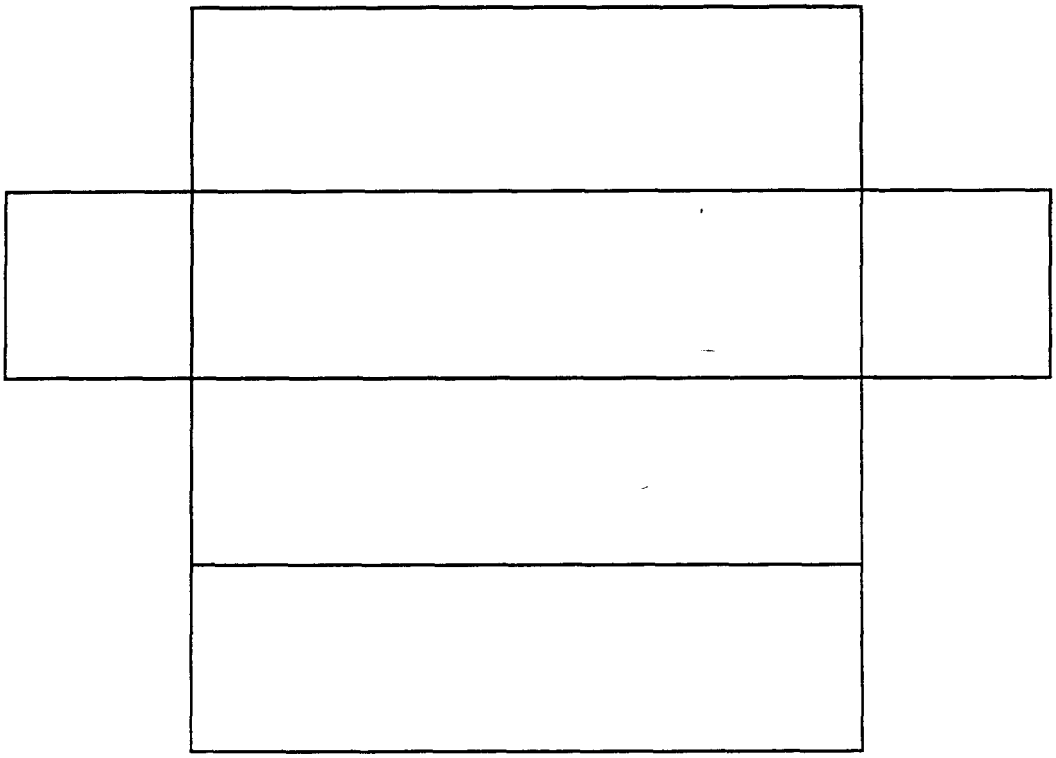


All of the faces, <u>including</u> the bases, make up the **surface area** of a prism.

Amount of Surface Area

Surface area is all of the faces, <u>including</u> the bases.

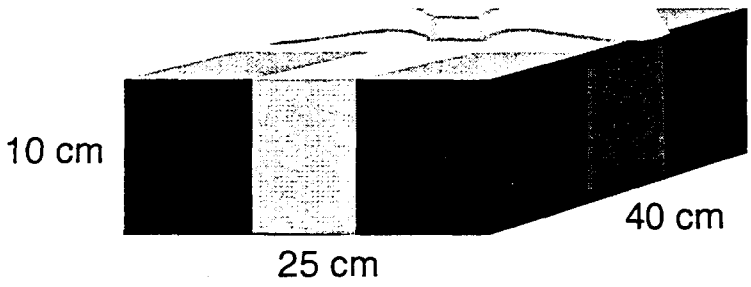
What is the total amount of surface area on this prism?



Akeem's Gift

Akeem has a gift for his brother. He wants to wrap the gift with some special paper.

Akeem has 3,000 square centimeters of paper. Does he have enough paper to wrap the box as shown below?



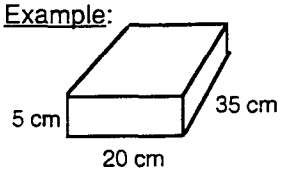
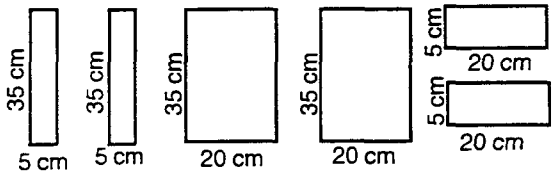
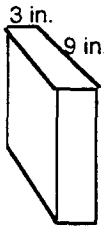
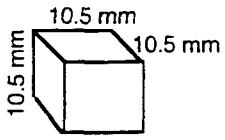
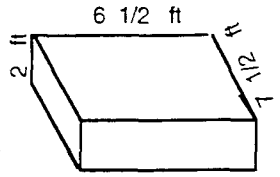
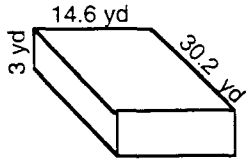
Show how you got your answer:

Name _____

Date _____

Finding Surface Area

Draw <u>all</u> of the faces for each prism. Label the lengths and widths of each face. Then find the total amount of surface area for each prism.

Prism	**Faces** (including bases)	Total **Surface Area**
Example:  	 	175 sq cm 175 sq cm 700 sq cm 700 sq cm 100 sq cm + 100 sq cm **1950 sq cm**
 		
 		
 		
 		

Name _____

Date _____

Surface Area of Rectangular Prisms

How many different rectangular prisms you can build with the given number of cubes?

- Build all possible prisms.
- Write the length, width, and height of each prism. These are called **dimensions**.
- Find the surface area of each prism.

Number of Cubes	Length, Width, and Height	Surface Area in Square Units
12	Example: 3 x 2 x 2	32 sq units
16		
18		
24		

For each number of cubes above, circle the dimensions that give the greatest surface area. Draw a box around the dimensions that give the least surface area.

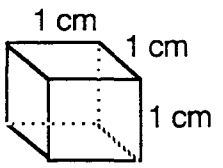
What do you think the shape of a rectangular prism has to do with its surface area? Write your answer on the back of this paper.

Exploring Volume

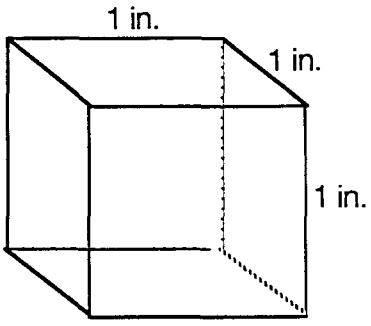
Volume is the amount of space inside a three-dimensional figure.

We measure volume by the number of cubic units that fit inside a space figure. There are many kinds of cubic units. Here are two.

Cubic units measure the same on all sides!

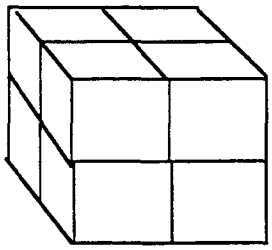


cubic centimeter



cubic inch

Example:



Count the number of cubes!

The **volume** of the cube is 8 cubic centimeters.

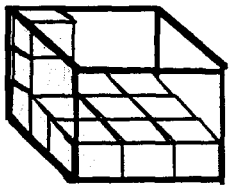
Volume = 8 cm^3

Name _____

Date _____

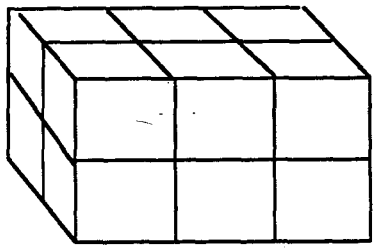
Finding Volume

Example 1



Volume = _____

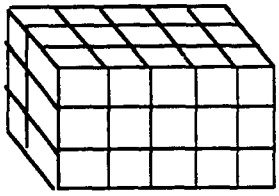
Example 2



Volume = _____

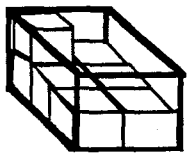
Find the volume of each prism. Each block is one cubic centimeter.

1.



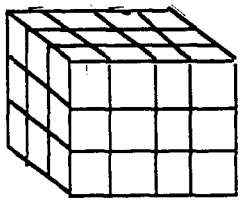
Volume = _____

2.



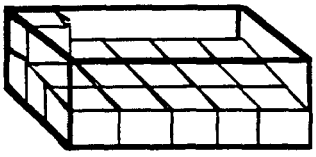
Volume = _____

3.



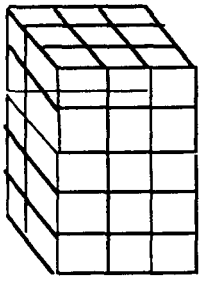
Volume = _____

4.



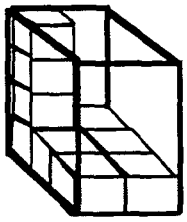
Volume = _____

5.



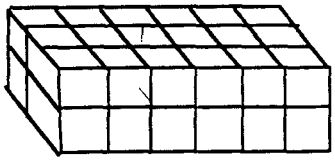
Volume = _____

6.



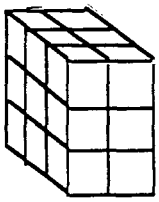
Volume = _____

7.



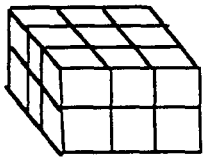
Volume = _____

8.



Volume = _____

9.

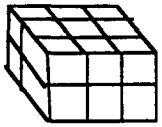


Volume = _____

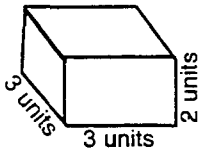
Name _____
Date _____

Volume of Rectangular Prisms

Look at the rectangular prism. Count the cubes to find the volume of the prism.
The volume is _____ cubic units.



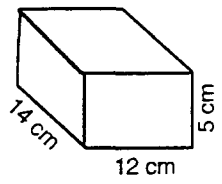
Here is another picture of the same rectangular prism. Remember that a formula in math tells how to do something. Can you write a formula for finding the volume of a rectangular prism?



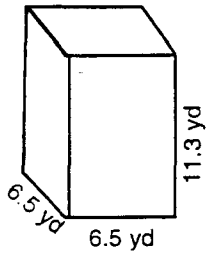
The formula for finding the volume of a rectangular prism is V = _____ .

Use the formula to find the volume of these rectangular prisms. Show your work.

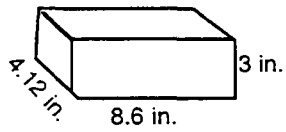
1.



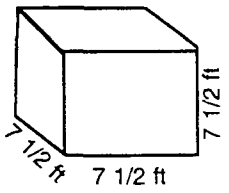
2.



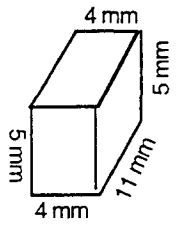
3.



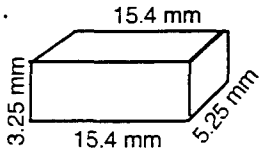
4.



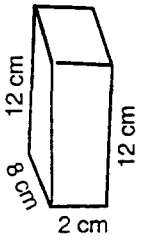
5.



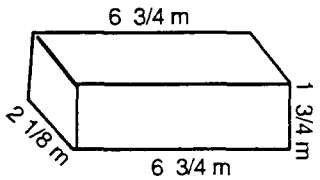
6.



7.

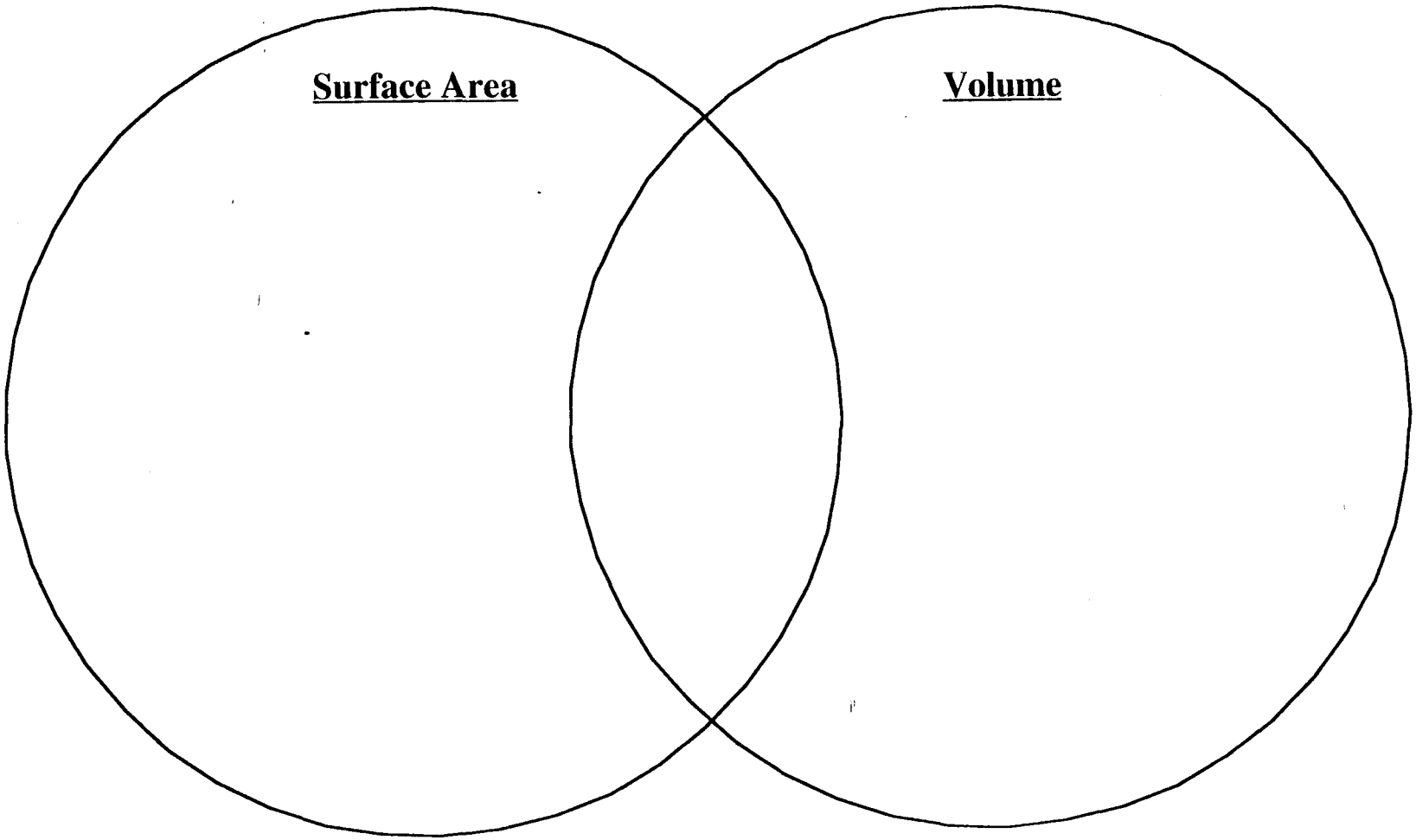


8.



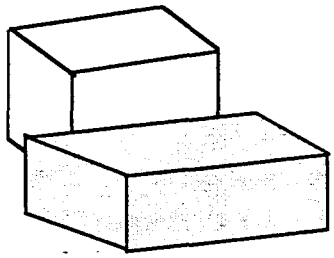
Name _____

Surface Area vs. Volume



Name _____

Date _____



Investigating Boxes

Use two small cardboard boxes with different shapes and sizes for this activity. Label them Box 1 and Box 2. Look carefully at your boxes.

VOLUME

The volume of the box measures how much it can hold. Volume is measured in cubic units. Think about which box holds <u>more</u> cubic units.

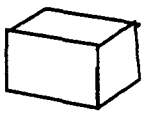
<u>Prediction</u>: I think that Box _____ can hold <u>more</u> cubic units.

TASK: <u>Measure thevolume of each box.</u>

1) COUNTING: Place centimeter cubes side-by-side into each box. Fill each box from the bottom to the top as close as possible. Record the total number of cubes used for each box in the column "Volume (Counting)" on the chart on page 3.

2) FORMULA: Measure the length, width, and height of each box to the nearest tenth of a centimeter with a metric ruler. Multiply to find the volume to the nearest tenth of a centimeter. ($V = l \times w \times h$) Record the volume of each box in the column "Volume (Formula)" on the chart.

SURFACE AREA



The total surface area of a box is the number of square units that cover the outside faces. Think about which box has the greatest and least number of square units on the six outside faces.

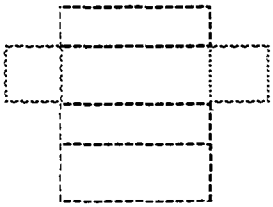
Predictions: I think that Box ____ has the greatest number of square units on the six outside faces.

I think that Box ____ has the least number of square units on the six outside faces.

TASK: Measuresurface area of each box.

1) USING A NET: Trace the six faces of one of the boxes onto centimeter grid paper. Cut out the faces and glue them onto paper to make a net. Be sure the net would fold into the shape of the box.

Sample net:



Repeat the same procedure for the second box. Count the number of square units in each net as close as possible. Record the total number of square units of surface area for each box on the chart.

2) COMPUTATION: Measure the length and width of each of the faces of one box to the nearest tenth of a centimeter using a metric ruler. Multiply to find the area of each face and then add the six areas together to find the total surface area. ($A = l \times w$) Repeat the same procedure for the second box. Record the total surface area of each box to the closest tenth of a centimeter.

Box Number	Volume (Counting)	Volume (Formula)	Surface Area (Using Net)	Surface Area (Computation)

1) Which method for finding volume is more accurate, counting or using a formula? Why? _____

_____

2) Which method for finding total surface area is more accurate, using a net or using computation? Why? _____

_____

3) Box 1 has _____ square units of surface area for _____ cubic units of volume.

4) Box 2 has _____ square units of surface area for _____ cubic units of volume.

5) Did you discover anything unusual about surface area and volume? Explain.

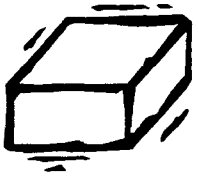
_____

_____

Name _____

Notes : Understanding Volume

AboutVolume



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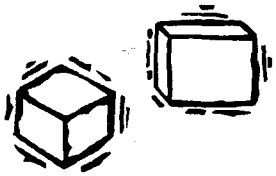
About Cubic Units



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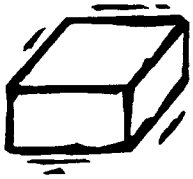
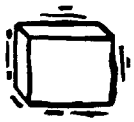
Understanding Volume

AboutVolume



- Volume is the amount of space **inside** a three-dimensional figure.
- It is measured in **cubic units.**
- It is the number of cubic units needed to **fill** the **inside** of the figure.

About Cubic Units



- Cubic units measure the **same** on all sides.
  A cubic centimeter is one centimeter on all sides, a cubic inch is one inch on all sides, etc.
- Cubic units can be shortened using the exponent **3.**
  6 cubic cm = 6 cm^{3} ←
- **Different** cubic units can be used to measure the volume of space figures - cubic inches, cubic yards, centimeters, etc.

Answer Key
Objective 54

Finding Surface Area

1) Faces

		Total Surface Area
(2 of each)	3 x 9; 9 x 12; 3 x 12	27 + 27 + 108 +108 + 36 +36 = 342 sq in
(6 of each)	10.5 x 10.5	110.25 x 6 = 661.5 sq mm
(2 of each)	2 x 7.5; 7.5 x 6.5; 2 x 6.5	15 + 15 + 48.75 + 48.75 + 13 + 13 = 153.5 sq ft
(2 of each)	3 x 30.2 ; 30.2 x 14.6; 3 x 14.6	90.6 + 90.6 + 440.92 + 440.92 + 43.8 + 43.8 = 1150.64 sq yd

Finding Volume

1) 45 c^3
2) 12 c^3
3) 36 c^3
4) 30 c^3
5) 45 c^3
6) 24 c^3
7) 36 c^3
8) 18 c^3
9) 18 c^3

Volume of Rectangular Prisms

Vol = 18 cubic units
Vol = length x width x height

1) 840 cm^3
2) 477.43 yd^3
3) 106.3 in^3
4) 421.88 ft^3
5) 220 mm^3
6) 262.76 mm^3
7) 192 cm^3
8) 25.1 m^3

Investigating Boxes

Answers will vary.

Probability, Statistics and Data Analysis

Obj. 51: Determine the probability of a single outcome (independent) events, recognizing that the probability of certain events is 1, impossible events is 0, and all others lie between 0 and 1.

Vocabulary

probability
experimental probability
theoretical probability
possible outcomes
favorable outcomes
trials

Materials

coins

Probability transparency or
overhead spinner and number cubes

Probability Practice
student copies

Language Foundation

1. Relate **probability** to the word probable. If something is probable, there is a good chance it will happen. Tell students that probability is the study of chance.

2. Ask students what they do in science when they do an experiment. (They try to test or discover something.) Relate **experimental** to experiment. An experiment tells us if what we expect really happens. Tell students for experimental probability, they will be doing an experiment a number of times. (rolling a number cube, flipping coins, etc.)

3. Relate **theoretical** to the word theory (idea we believe is true). For theoretical probability, you would use a formula and figure out the probability on paper rather than conducting an experiment.

4. Explain the difference between **trial** relating to the law (court, judge) and trying something a number of times.Tell students when they do something several times, those are trials. Give examples from sports where there are trials. (long jump, gymnastics-vault, etc.)

Mathematics Component

1. Introduce the concept of probability to the class.
   - Show the students a coin and ask one of them to choose heads or tails.
   - Flip the coin but cover the results.
   - Ask students, " What is the chance that the student has guessed correctly?" Students should give responses such as : 1out of 2, 50%, 1/2, etc.
   - Show the result.
   - Explain that **probability** is a mathematical way of representing the chances that something will or will not happen. It can be expressed as a ratio, fraction, decimal or percent.
   - Ask students to think of real life applications of probability. (Example might include a 50% chance of rain in the weather forecast or drawing a certain color jelly bean from a candy jar, etc.))

2. Conduct an experiment with the class. Show students a penny and demonstrate flipping a coin. Discuss possible ways the coin can land. Say, "What do you think the the probability is that the coin will land on heads? Tails?"
   - Give each pair of students a penny.
   - Explain that the class will do an **experiment** to find out how often the coin lands on heads and how often it lands on tails. Tell them one student in each pair should flip the coin 20 times and the other should record the results.
   - Tabulate the results for the entire class. Tell them you will use these results to determine the **experimental probability**. Experimental probability is based on the results of a small number of **trials**.
   - Explain to the students that as more tosses are competed the results should become closer and closer to 50% . The number 50% is the mathematical or **theoretical probability**. It tells us what we can expect from a larger number of trials.
   - Ask the students why they think a coin is flipped at the beginning of some sporting events. (A coin allows each participant an equal 50/50 chance of winning.)

3. Investigate other probability tools.
   - Place the Probability transparency on the overhead. (Overhead spinner and/or number cube may be used instead.)
   - Ask the students if you were to spin the spinner, how many different outcomes are possible. (4)
   - Ask the students the probability of spinning a 4. (1 out of four)
   - Demonstrate how to write the answer as a ratio. (1/4)
   - Ask the students what they think the four represents (**possible outcomes**) and what they think the 1 represents (**favorable outcomes**).
   - Follow up with the following questions:

     What is the probability of spinning a 3? (1/4)

     What is the probability of spinning an even number? (2/4= 1/2)

Note: be sure to emphasize that the ratios should be in lowest terms.

What is the probability of spinning a number less than 10? (4/4=1/1)

Note: be sure to emphasize that if something is definitely going to happen it has a probability of 1.

What is the probability of spinning a 5? (0)

Note: be sure to emphasize that if something is definitely NOT going to happen it has a probability of 0.

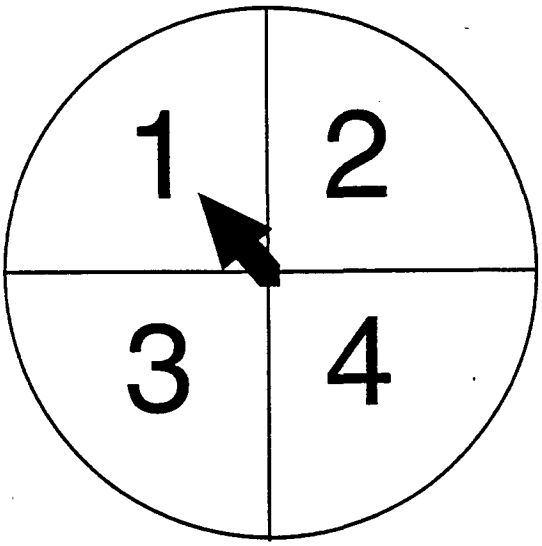
- Hold up a 6 - sided number cube. Assure the students that it is numbered 1-6. Ask questions such as those in the previous activity. Have students make up questions for other students.

4. Individual practice.
   - Students complete Probability Practice

Additional Activities

Problem Solving Activity

- Distribute Skydiving to each student


1
2
3
4

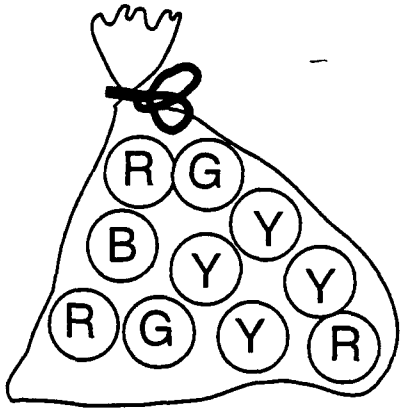
Name _____

Date _____

Probability Practice

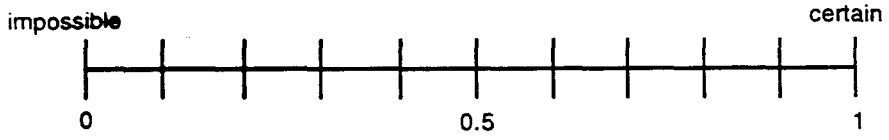
You have 10 marbles in a bag. You have 3 red marbles, 2 green marbles, 4 yellow marbles and 1 blue marble. Without peeking, you reach in an pull out one marble. Find the probability of each outcome. Express your answer as a fraction in lowest terms.

1. P(red) _____
2. P(yellow) _____
3. P(green) _____
4. P(blue) _____
5. P(purple) _____
6. P(not blue) _____
7. P(red or yellow) _____



The probability of an event is between 0 and 1. The greater the probability, the greater the chances the event will happen. If an event is impossible, the probability that it will occur is 0 or 0%. If an event is certain to happen, the probability that it will occur is 1 or 100%.

On the number line below, place the letter of each event below on the number line at the spot that best describes its probability.



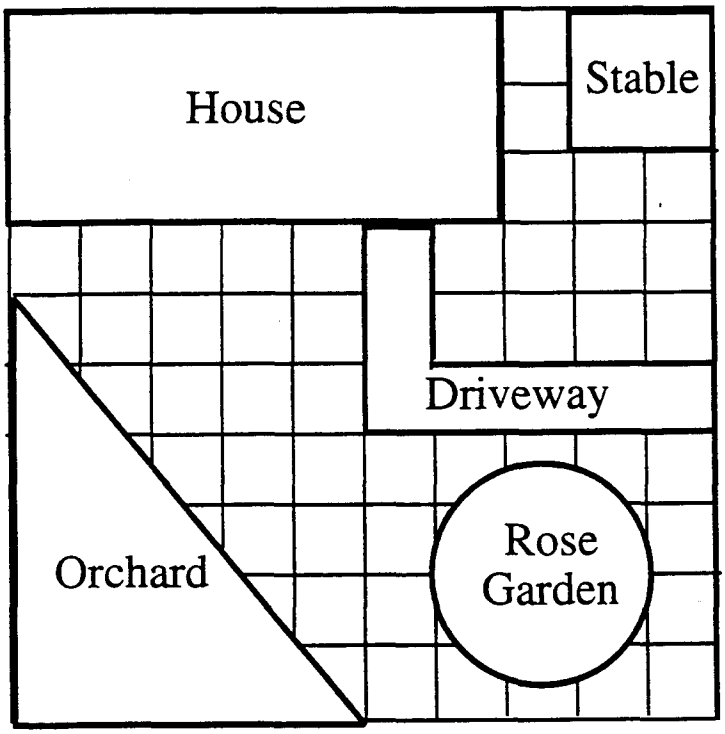
a. you will get a head when you toss a coin
b. you can run 20 miles in one hour
c. the sun will rise tomorrow
d. it will snow in Minnesota next winter
e. you will listen to a cd today

Name _____ Problem Solving Activity
Date_____

Skydiving

Materials: task paper, calculator, ruler (optional)

You are making a plan for your first skydiving adventure! You are planning to jump out of an airplane with a parachute and land safely in your math teacher's yard. Below is a map of the property. Use the map and what you know about area and probability to answer the following questions. All answers should be expressed as fractions in the lowest terms



* If necessary round to the nearest whole number

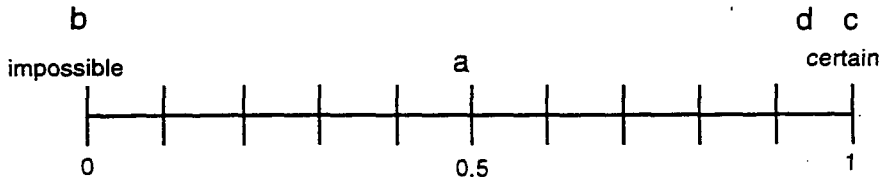
What is the probability that you will land on the following objects:

1. House _____
2. Rose Garden _____
3. Orchard _____
4. Driveway _____
5. Stable _____
6. free space (all space with out objects is grassy free space) _____

Answer Key
Obj. 51

1. P(red) 3/10
2. P(yellow) 2/5
3. P(green) 1/5
4. P(blue) 1/10
5. P(purple) 0
6. P(not blue) 9/10
7. P(red or yellow) 7/10

Answers may vary for number line. Accept all reasonable answers.



Objective 52: **Determine the mean, median, mode, and range of a given set of data and record the central tendency using the most appropriate measure.**

Vocabulary

data
central tendency
mean
median
mode
range
appropriate

Materials

Central Tendencies #1
transparency

Central Tendency Practice
An Average Score
student copies

Language Foundation

1. Explain that **data** is information that we can collect from many sources (books,TV, newspapers,people). Some ways to collect data are by survey, interview, or questionnaire. Ask students if anyone has ever collected data from them. What kind of data could the class collect? (favorite singers, pets, ice cream flavors, etc.)

2. Tell students 'med' often refers to middle. Relate the word **median** to examples of things in the middle, such as medium in size(S,**M**,L) highway median, mediator (person in the middle who helps with a problem).

3. Explain that **appropriate** means suitable or proper. Have students find part of the word 'proper' in ap**propr**iate. Tell them people must wear appropriate clothing to work. Ask for examples of things in school (clothing, behaviors) that are and are not appropriate. In this lesson they will learn to find the most appropriate measure of central tendency.

Mathematics Component

1. Introduce the concept of central tendency.
   - Place the Central Tendency Transparency #1 on the overhead projector. Use a cover sheet and display only the data set.
   - Ask the students how they would describe the set of data to someone. Possible answers might include statements such as the largest shoe size is a 1, most kids wear an 8, etc. Explain to the students that there are mathematical ways to describe sets of data. These ways are called **central tendencies**.
   - Pass out a copy of the transparency to each of the students. Uncover each of the definitions and use the given data set of data to find and record each type of central tendency with the class.
   - Discuss which measure best describes the data. In this case, all are about the same.
   - Ask students to think about what would happen if the data included a very small shoe size. What measure would best describe the data? (The mean would not be the best measure if a very small number were included because it would not show the true middle .)
   - Explain that certain measures may sometimes be more appropriate to describe a set of data.

2. Handout a Central Tendency Practice page to each student.
   - As a class take a **survey** to collect a set of data by using the following procedure.
     Ask each student the question, "How many brothers and sisters do you have?" Create a tally sheet to organize the responses. Have each student record the final data on their individual worksheet.
   - After each student has answered the question and recorded the final data, have students work with a partner and complete individual activity sheets.
   - Calculators may be used.
   - Share answers with class.

3. Distribute An Average Score to each student and work the problem as a class.

Additional Activities

Create a second problem solving situation similar to the one in number 3 above, using class or school data. For example, if the school is collecting grocery store receipts you might set a goal for the **average** number to be collected each day for five days. Record the number brought in each day for the first four days. Then, have students figure out how many **need** to be brought in on the fifth day to meet the goal. Have students explain (orally or in writing) how they found the number needed on the fifth day.

Shoe Sizes in Math Class

6	8	7	9	10
7	8	9.5	12	9
8	7	9	8	8

Mean is the average of a set of data.

$$\text{mean} = \frac{\text{sum of data}}{\text{number of data}}$$

Median is the middle value when the data are listed in order of size.

Mode is the data occurring most frequently. There may be no mode, one mode or more than one mode.

Range is the difference between the smallest and the largest of a set of data.

Name _____
Date _____

Central Tendency Practice

As a class collect the following data:

How many brothers and sisters do you have?

Calculate the following:

mean

median

mode

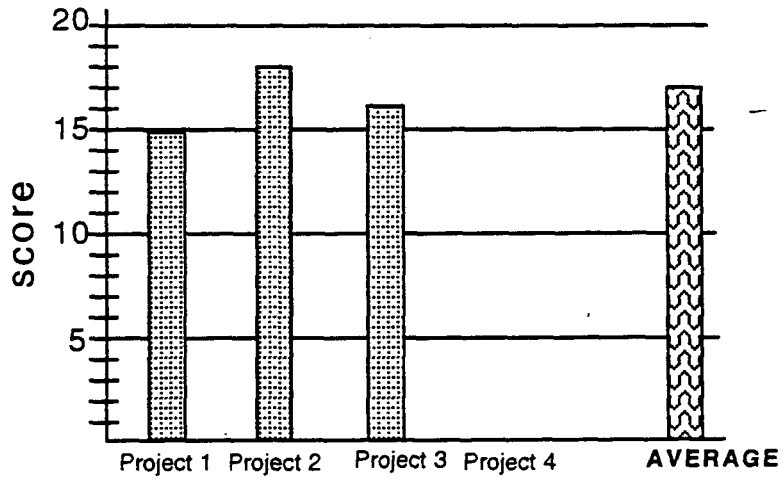
range

* Which central tendency best describes the data? Why?

Name _____ Problem Solving Activity
Date _____

An Average Score

Anita has four 20-point projects for science class. Anita's scores on the first 3 projects are shown below.



Problem:

What score must Anita get on Project 4 so that her average for the 4 projects is 17? _____

Let's think about this problem:

One way to solve this problem is to think about it in three parts:

1. What is the total number of points that Anita **has** earned so far? _____
2. If Anita earned 17 points on each of the four projects her average would be 17 and her <u>total</u> points for the four projects would be 68. Anita **wants** to have 68 total points.
3. So far, Anita has earned 49. How much more does Anita **need** so that she will have 68? _____

wants - has = needs

Answer Key
Obj. 52

Shoe Data Transparency

6, 7, 7, 7, 8, 8, 8, 8, 8, 9, 9, 9, 9.5, 10, 12

Mean $125 \div 15 = 8.\overline{36} = 8.4$

Median = 8

Mode = 8

Range = 6

An Average Score

1. Anita **has** 49 points.
2. Anita **wants** 68 points.
3. Anita **needs** 19 points.

Objective 53: Construct line plot.

Vocabulary

plot
line plot
data

Materials

chalkboard
post-it notes

Line Plot
transparency

Line Plot Practice
student copies

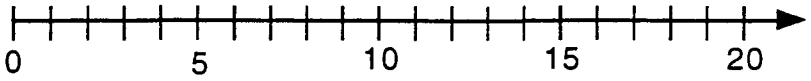
Language Foundation

1. Remind students that **data** is information.

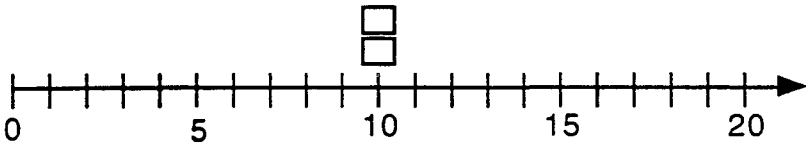
2. Data shown on a number line this is called a **line plot**. It is a kind of picture graph. Plot is used as a noun. When you mark a point on the number line, you **plot** the point. Plot is used as a verb here.

Mathematics Component

1. Construct a class line plot using the following directions:
   - Draw a number line on the chalkboard as shown below.



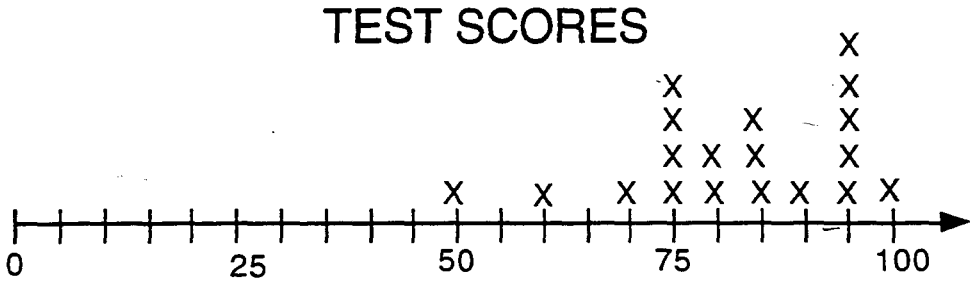
   - Give each student a post- it note.
   - Ask each student to place the post-it note above the number which represents the amount of money he or she thinks would be a fair allowance ($1 - $20) for one week. Post-it notes should stack up to show the number of responses for each number. The example below shows two pieces of data which represent $10 a week.



   - Once all students have placed their post it note ask the student the following questions:
   - What is the mode or the most common response?
   - What is the median or the middle piece of data?
   - Are there any responses which are far apart from the rest of the data?
   - How could you summarize our class data?
   - What are some of the strengths of this type of display?(organized data, simple to make, easy to find mode or median)

2. Provide additional practice reading a line plot.
   - Place Line Plot Transparency on the overhead projector. Tell the students that this type of display is called a **line plot**. Emphasize to the students that graphs are often named by the way they look. On this graph, the Xs have been "plotted on a line".
   - Ask the students questions similar to those above.

3. Provide an opportunity for students to create a line plot.
   - Have students complete Line Plot Practice.


TEST SCORES
0
25
50
75
100

Name _____

Date _____

Line Plot Practice

Number of Books Read over the Summer

8	12	5	7	20
5	10	11	5	12
8	11	5	9	6
9	10	11	7	5

Create a line plot to display the above data. Don't forget to give your graph a title.

Write three questions that could be answered by looking at your line plot. Include questions about mode and median.

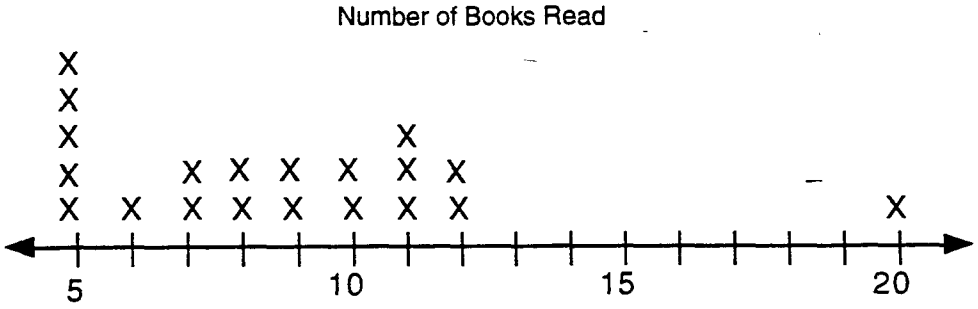
1. _____

2. _____

3. _____

Answer Key
Obj. 53

Line Plot Practice



Student questions will vary

Objective 54: Construct stem and leaf plot.

Vocabulary

stem and leaf plot

Materials

raisins, m&ms, or some other countable object
    one bag per student

How many did you have?
    transparency
Reading a Stem and Leaf Plot
    transparency
Steps for Creating a Stem and Leaf Plot
    transparency
    one per student
Stem and Leaf Plot Practice
    student copies

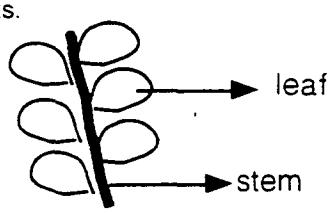
Language Foundation

1. If you have plants in the classroom, point out the **stem** and a **leaf**. If no plants are available, show or draw a picture of a plant and it's parts. Point out the plural: leaf → leaves

Mathematics Component

1. Collecting data.
   - Give each student a box of raisins (or other material/food).
   - Tell students that today we are going to find out if there are the same number of raisins in every box.
   - Ask students to open their box and carefully count the number of raisins.
   - Record each student's data on the How Many Did You Have? transparency.

2. Constructing a Stem and Leaf Plot.
   - Note for the students that the data is all out of order and tell them that you are going to show them a way to organize the data called a **stem and leaf plot.** Remind students that graphs are often named by the way that they look. You may want to draw a picture on the chalkboard like the one below or use a real plant to show plant parts.



   - Tell students that the graph that you are going to make looks like this picture.
   - Place the transparency Steps for Creating a Stem and Leaf Plot on the overhead projector. Distribute one copy to each student so they can work along with you.
   - Work through the steps together.

Example:

0	8 8 8 9 9
1	1 1 3 6 7 8 9 9
2	0 0 4 4 4 4 6 8 9
3	0 1 1

   - Discuss the results of the data and the significance. Ask questions such as:

     Why do some boxes of raisins have more than others? (Boxes are based on net weight; raisins vary in size.)

     What is the median? Mode?

     Are there any "**extremes**?" Extremes are numbers far apart from all of the others.

3. Reading a line plot.
   - Place the transparency copy of Reading a Stem and Leaf Plot on the overhead projector.
   - Ask the students questions similar to the questions above, such as, "What could have caused the 62 point game?"

4. Distribute student copies of the Stem and Leaf Plot Practice sheet for student to complete.

How Many Did You Have?

	A
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	
26	

Steps for Creating a Stem and Leaf Plot.

1. Look at your data.
   - Find the lowest value _____
   - Find the highest value _____

   Your stem will need to start from your lowest and go all the way to you highest.

2. Create the "stem" by putting the appropriate tens digit on the left side of the line below. For example if the answers were between 19- 32, you would need to put a 1,2, and 3 to represent tens,twenties and thirties.

3. From the spreadsheet work in order to create the "leaves". Each leaf is a one digit number representing the one digit of each piece of data. Write each leaf on the right side of the line above. Be sure to write neatly and line up you numbers.

4. Count your leaves to make sure you have not skipped any pieces of data.

5. Title your Stem and Leaf Plot.

Reading A Stem and Leaf Plot

Use the Stem and Leaf Plot below to answer the following questions.

Number of Points Scored in Basketball Games

2	2 4 4 5 6 9
3	5 5 5 6 7 7 7
4	0 1 1 2 5
5	
6	2

1. What was the least amount of points scored?
2. In how many games were 41 points scored?
3. In how many games were more than 36 points scored?
4. What is the mode or the most common response?
5. What is the median or the middle piece of data?
6. Are there any responses which are far apart from the rest of the data?
7. How could you summarize the data?
8. What are some of the strengths of this type of display?

Name _____

Date _____

Stem and Leaf Plot Practice

Test Scores

78	97	93	77	85
85	75	53	75	89
100	90	80	85	79
89	71	82	96	102

Create a stem and leaf plot to display the above data. Don't forget to give your graph a title.

Write three questions that could be answered by looking at your stem and leaf plot.

1. _____

_____

2. _____

_____

3. _____

_____

Answer Key
Obj. 54

Steps for Creating a Stem and Leaf Plot - answers will vary with class data.

Reading a Stem and Leaf Plot -

1. What was the least amount of points scored? 22
2. In how many games were 41 points scored? 2
3. In how many games were more than 36 points scored? 9
4. What is the mode or the most common response? 35 and 37
5. What is the median or the middle piece of data? 36
6. Are there any responses which are far apart from the rest of the data? yes, 62
7. How could you summarize the data? (answers will vary)
8. What are some of the strengths of this type of display? organizing the data, simple to make, easy to find mode or median

Stem and Leaf Practice

Test Scores

5	3
6	
7	1 5 5 7 8 9
8	0 2 5 5 5 9 9
9	0 3 6 7
10	0 2

Student questions will vary.

Obj. 55: Construct box plots.

Vocabulary

median
lower / first quartile
upper/third quartile
least value
greatest value
box and whisker plots
quadrant

Materials

Box and Whisker Plot
transparency
student copies

Box and Whisker Plot Practice
student copies

Language Foundation

1. Explain that in the word **quartile**, "quart" refers to things divided into four parts. Give examples such as: quart (4 quarts=1gal)
   quarter (4 quarters= $1)

2. Show students a picture of a cat and point out the **whiskers**. Explain that they will be graphing data and parts of the graph will look like "whiskers".

3. Ask students what "quad" means in the word **quadrant.** (four) Explain that quadrant means four areas. Remind students that we used quadrants when graphing on a coordinate plane.

Mathematics Component

1. Involve the students in creating a human box and whisker plot.
   - Collect the following materials: string or yarn and signs that say the following: median, lower/first quartile, least value, upper/third quartile, greatest value
   - Explain to the students that they are going to help you create a new kind of graph.
   - Ask 15 students to come to the front of the class room or to some other large space. Tell the class that these students represent 15 pieces of data.
   - Tell the class that the first step in creating this type of plot is to put the data in order from least to greatest. Ask the students to put themselves in order from shortest to tallest.
   - Tell the students that the next step is to find 5 important data points: the median, the least value, the greatest value, the lower or first quartile and the upper or third quartile.
   - Ask the students to tell you the least and the greatest value. Hand the first and last students the appropriate sign (least value and greatest value) to hold so that the class can see them.
   - Ask the students how they could find the median of the data. One of the students should come up with the idea of counting in to find the middle person. Hand the middle student the median sign to hold.
   - The concepts of lower quartile and upper quartile are more difficult for students. Emphasize the idea that they are finding the middle of the lower half of the data and the middle of the upper half of the data. Use the same process as you did for finding the median, count into the fourth person and the twelfth person. **Do not** count the median when finding the middle of each of the halves. Give signs (lower/first quartile and upper/third quartile) to the appropriate students. Emphasize to the students that the data is now broken into 4 **quadrants**.
   - Ask all students not holding a sign to sit down. Emphasize to the students that in this type of graph, **only** these five pieces of data are displayed .
   - Quickly measure a piece of string/yarn that reaches from the lower to the upper quartile. Tie the string/yarn into a circle.
   - Hand the upper quartile person and the lower quartile person the circle of string. Ask them to hold the string/yarn with both hands and form a box shape. The median person should be in the box.
   - Hand the median person a piece of string/yarn to hold vertically inside the box.
   - Tie a piece of sting/yarn to the left side of the "box" and stretch it to the least value. Have the least value student hold the string. Do the same thing on the right side of the box.
   - Tell the students that the name of this graph is a **box and whisker plot.** Point out the **"box"** shape to the students. Explain that the two strings/pieces of yarn extending out from the sides of the box to the least and greatest values are called the **"whiskers,"** like the whiskers on a cat.

2. Construct a box and whisker plot with numerical data.
   - Place the Box and Whisker Plot transparency on the overhead projector.
   - Give each of the students a paper copy of the transparency so they may work along with you.

- Work through the transparency step b tep, making sure students are following along.
- Check students' work to check final b ots.

3. Individual practice
   - Students should use completed example to help them complete Box and Whisker Plot Practice.

Scores on a Science Test

Data → 86 91 76 67 88 96 100
75 95 62 90 87 99

1. Put data in order from least to greatest:

2. Use the data placed in order above.
   1. Circle the **least value**.
   2. Circle the **greatest value**.
   3. Circle the **median**.
   4. Circle the **first quartile** (lower quartile).
   5. Circle the **third quartile** (upper quartile).

3. Draw a number line below. Draw dots in the appropriate place under the number line to represent the five pieces of circled data.

   1. Connect the **lower** and **upper quartile** dots by drawing a box from one to the other.
   2. Draw a vertical line in the box which goes through the **median** dot.
   3. Draw whiskers from the end of box to the dots representing the **least and greatest values**.
   4. Title the graph.

You've done It!!

Name _____
Date _____

Box and Whisker Plot Practice

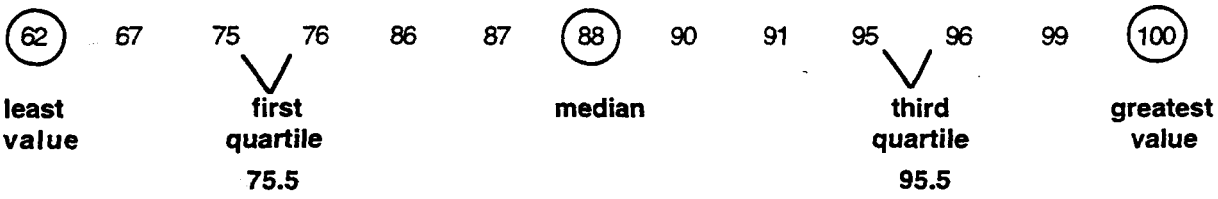
Create a Box and Whisker Plot using the data below.

Gasoline Mileage (Miles Per Gallon)

24	20	18	25	22	31	30
20	28	29	35	24	38	

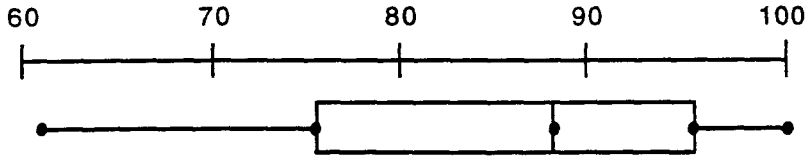
Answer Key
Obj. 55

Box and Whisker Plot Transparency

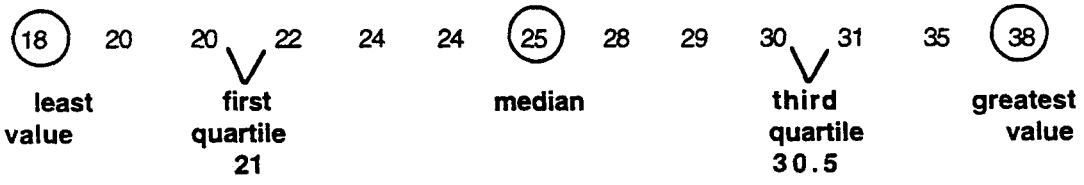


Note: If there is no exact midpoint, you need to find the upper and lower quartile by averaging. Remember, do not include the median when determining the first and third quartiles.

Test Scores



Box and Whisker Plot Practice



Gasoline Mileage